ETHEKWINI MUNICIPALITY

HOUSING TYPOLOGIES STUDY
CONSTRUCTION CONSIDERATIONS

PRESENTATION 5/5

PROJECT OVERVIEW

1 INTRODUCTION

- THIS PROJECT HAS BEEN INITIATED BY THE ARCHITECTURE DEPARTMENT OF THE ETHEKWINI MUNICIPALITY TO DEVELOP HOUSING TYPOLOGIES FOR THE DELIVERE OF NEW PROJETS AND EXISTING SETTLEMENT UPGRADE PROJECTS IN THE ETHEKWINI MUNICPAL REGION
- THE STUDY IS TO INTEGRATE TOWN PLANNING, URBAN DESIGN AND ARCHITECTURE COMPONENTS
- THE INTENTION IS TO IDENTIFY PRACTICES WHICH OPTIMISE BOTH THE QUALITY AND SUSTAINABILITY OF RESULTANT LIVING ENVIRONMENTS

2 BACKGROUND

- DESPITE THE DELIVERY OF ALMOST 2 MILL HOUSING UNITS BY GOVERNMENT SINCE 1994, THE DOMINANT HOUSING TYPOLOGY CONTINUES TO BE DETACHED, SINGLE FAMILY HOMES ON LARGER FREE HOLD PLOTS
- THE INCREASING PRESSURE ON URBAN LAND, DEMANDS FOR OPTIMISING EXISTING SERVICE INFRASTRUCTURE AND THE NEGATIVE SOCIO-ECONOMIC IMPLICATIONS OF DEVELOPING ON THE URBAN PERIPHERY HAVE NECESSITATED A REVIEW OF THE LOCATION AND DESIRED DENSITIES OF HOUSING SETTLEMENTS
- IT HAS BECOME NECESSARY THAT THE SUPPLY OF HOUSING BE MORE RECEPTIVE TO THE REDEVELOPMENT OF SITES LOCATED WITHIN ALREADY SERVICED AND DEVELOPED AREAS AS WELL AS THE UPGRADING OF EXISTING SETTLEMENTS
- A STUDY AND DEVELOPMENT OF AFFORDABLE HOUSING TYPOLOGIES APPLICABLE TO PREVAILING LOCAL CONDITIONS (TYPOGRAPHY, CLIMATE, TECHNOLOGIES AND FINANCE) WILL ASSIST IN MEETING THE URBAN HOUSING CHALLENGE WITH GREATER AUTHORITY, EFFICIENCY AND UNDERSTANDING

3 PROJECT OBJECTIVES

- TO INFORM THE OPTIMISATION OF QUALITY AND SUSTAINABILITY IN THE DESIGN AND ONGOING DELIVERY OF SUBSIDY HOUSING
- TO DETERMINE OPTIMAL HOUSING TYPOLOGIES FOR APPLICATION IN INFORMAL SETTLEMENT UPGRADING AND GREENFIELD PROJECTS WITHIN THE URBAN AREA OF ETHEKWINI

4 DEFINING HOUSING TYPOLOGY

- HOUSING TYPOLOGY ENCOMPASSES ATTRIBUTES OF FUNCTION AND CONFIGURATION CHARACTERISTICS OF PUBLIC AND PRIVATE BUILDINGS AND THE SPACES AROUND THESE BUILDINGS THROUGH CONSTRUCTION
- TYPOLOGY MUST CONSIDER ASPECTS OF TOWN PLANNING AND URBAN DESIGN AS WELL AS THE DETAIL OF MULTI-UNITS OR RESIDENTIAL CLUSTERS
- TYPOLOGY HAS A TIME DIMENSION AND THEREFORE MUST CONSIDER FLEXIBILITY, ADAPTABILITY AND TRANSFORMATION OVER TIME
- THE QUALITY OF HOUSING TYPOLOGY MUST CONSIDER CONTEXT WHICH IS DEPENDANT ON A NUMBER OF FACTORS INCLUDING THE LOCATION OF SERVICES, THE BALANCE BETWEEN PRIVATE, SEMI PRIVATE, COMMUNAL AMD PUBLIC SPACE, THE MIX OF RESIDENTIAL AND NON-RESIDENTIAL USE AND THE END-USERS SOCIAL AND CULTURAL STRUCTURES
- IN ETHEKWINI THE CONSIDERATION OF TYPOLOGY IN RELATION TO TOPGRAPHY IS CRITICAL AS MANY INFORMAL SETTLEMENTS ARE FOUNDED ON STEEP AND UNSTABLE LAND. STEEP SLOPES IMPOSE HIGHER BUILDING AND INFRASTRUCTURE COSTS AND CREATE DIFFICULTIES OF ACCESS REQUIRING GREATER CARE IN THE DESIGN AND LAYOUT OF HOUSES

PROJECT STRUCTURE

1 PRECEDENTS AND LITERATURE OVERVIEW

2 PILOT PROJECT OVERVIEW

3 BUILDING THE PRINCIPLES

4 MATRIX OF TYPOLOGIES

5 DESIGN CONSIDERATIONS

PROJECT STRUCTURE

1 PRECEDENTS AND BIBLIOGRAPHY

- KEY ISSUES TO INFORM THE BRIEF
- BIBLIOGRAPHY AND SYNOPSIS OF RELEVANT LITERATURE
- REVIEW OF CASE STUDIES
- FINDINGS TO OFF SET NEGATIVE TRENDS

2 PILOT PROJECT OVERVIEW

- AREA / INFRASTRUCTURE AUDIT
- SITE ANALYSIS
- READINESS FOR DEVELOPMENT AND IMPLICATIONS FOR TYPOLOGY SELECTION

3 BUILDING THE PRINCIPLES

- GUIDING PRINCIPLES FOR HOUSE DESIGN AND URBAN LAYOUTS

4 MATRIX OF TYPOLOGIES

- SUMMARY OF HOUSING TYPOLOGIES
- FINAL HOUSING TYPOLOGY DESIGNS
- COSTINGS

5 DESIGN CONSIDERATIONS

- DENSITY AND TOPOGRAPHICAL CONSIDERATIONS
- MATERIALS AND MINIMUM QUALITY LEVEL CONSIDERATIONS
- SERVICING AND SUSTAINABILITY CONSIDERATIONS

CONTENTS

SYNOPSIS

THIS SECTION EXAMINES THREE CRITICAL ASPECTS OF THE DESIGN PROCESS THAT NEED TO BE CONSIDERED BEFORE CHOICES CAN BE MADE ON THE APPROPRIATE TYPOLOGY TO UTILISE IN ANY SPECIFIC PROJECT.

THE THREE ASPECTS THAT ARE TO BE CONSIDERED ARE:

1 DENSITY AND TOPOGRAPHICAL CONSIDERATIONS

2 MATERIALS AND MINIMUM QUALITY LEVEL CONSIDERATIONS

3 SERVICING AND SUSTAINABILITY CONSIDERATIONS

CAREFUL CONSIDERATION OF THE ABOVE, IN ADDITION TO THE ARCHITECTURAL DESIGN, WILL ENSURE THE SELECTED TYPOLOGIES ARE COST EFFECTIVE, ENERGY EFFICIENT, SOCIALLY ACCEPTABLE AND SPATIALLY PRACTICAL. IN OTHER WORDS THE UNITS ARE NOT JUST HOUSES, BUT CAN BECOME HOMES AND INVESTMENTS AND CONTRIBUTE MEANINGFULLY TO THE FUNCTIONING OF THE BROADER URBAN STRUCTURE.

DENSITY AND TOPOGRAPHICAL CONSIDERATIONS

SYNOPSIS

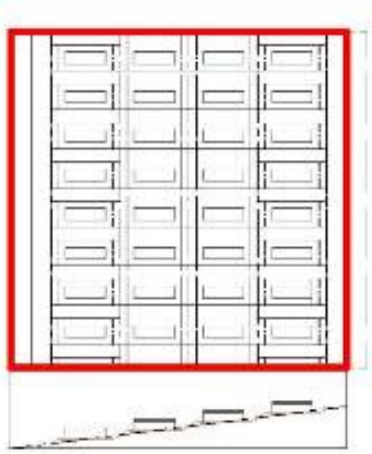
THIS SECTION AIMS TO ASSIST IN THE PROCESS OF SELECTING AN APPROPRIATE HOUSE TYPE TO UTILISE IN A PARTICULAR PROJECT.

IN PARTICULAR AN UNDERSTANDING OF HOW THE CHOICE BETWEEN NARROW, MEDIUM OR WIDE FRONTAGE UNITS ON DIFFERENT GRADIENT SLOPES CAN AFFECT DENSITY AND URBAN FORM IS BUILT.

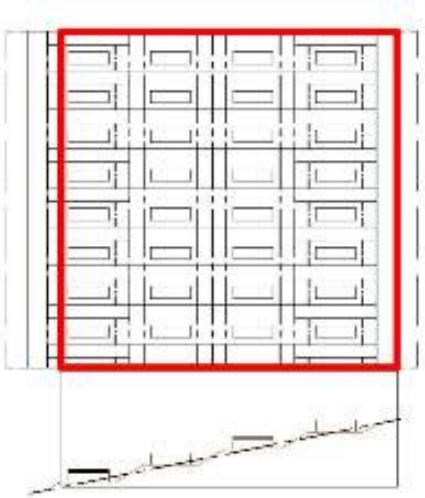
THIS SECTION ILLUSTRATES HOW DENSITY IS COMPROMISED AND COSTS INCREASE ON STEEPER SLOPES IF INCORRECT HOUSE TYPES ARE USED. FOR COMPARATIVE PURPOSES NATURALLY REPOSED CUT AND FILL PLATFORMS ARE ILLUSTRATED AND COMPARED WITH ALTERNATIVE PLATFORM TYPES SUCH AS PILLAR AND POST OR RETAINING WALLS, WHICH ALTHOUGH MORE EXPENSIVE, RETAIN HIGHER DENSITIES AND MORE COMPACT URBAN ENVIRONMENTS IS ALSO ILLUSTRATED FOR CONSIDERATION.

NOTE: STATED DENSITIES ARE INDICATIVE AND FOR COMPARATIVE PURPOSES AS THEY DO NOT TAKE INTO ACCOUNT CHANGING TERRAIN, AND THE NEED FOR NON-RESIDENTIAL FACILITIES. LAYOUTS ARE ALL BASED ON MINIMAL ROAD PROVISION BY USING PANHANDLE LAYOUTS.

NARROW FRONTAGE HOUSING TYPOLOGY (DETACHED) - DENSITY COMPARISON



SLOPE = < 1:8 GENTLE
UNIT SIZE = 43m²
SITE SIZE = 156m² - 238m²
DENSITY = 38/ha



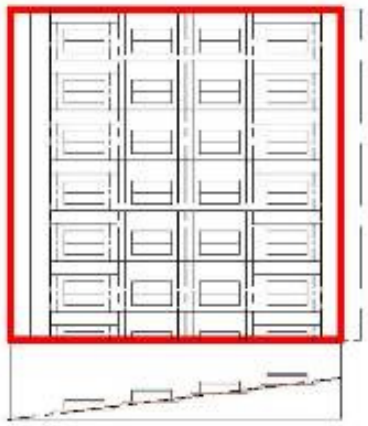
SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 40m²
SITE SIZE = 187m² - 285m²
DENSITY = 31/ha

NARROW FRONTAGE DETACHED UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 36 UNITS/HA ON GENTLE SLOPES TO 15 UNITS/HA ON VERY STEEP SLOPES.

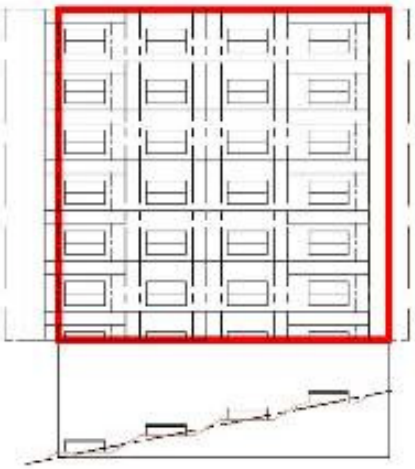
SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 40m²
SITE SIZE = 290m² - 442m²
DENSITY =21/ha

SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 40m²
SITE SIZE = 398m² - 607m²
DENSITY = 15/ha

NARROW FRONTAGE HOUSING TYPOLOGY (SEMI-DETACHED) - DENSITY COMPARISON

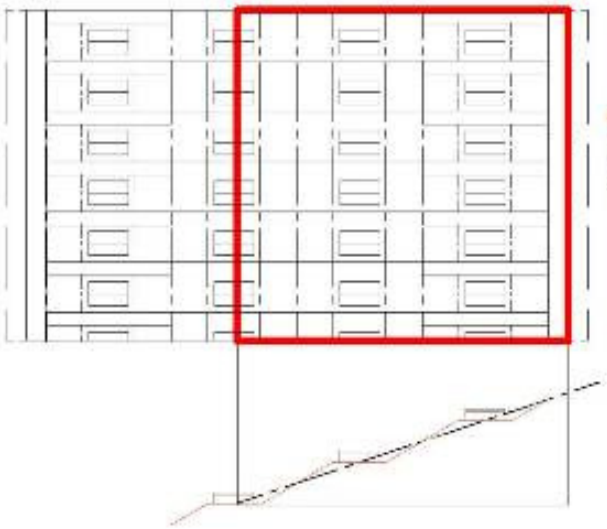


SLOPE = < 1:8 GENTLE
UNIT SIZE = 40m²
SITE SIZE = 230m² - 312m²
DENSITY = 53.2/ha



SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 40m²
SITE SIZE = 276m² - 375m²
DENSITY = 45.5/ha

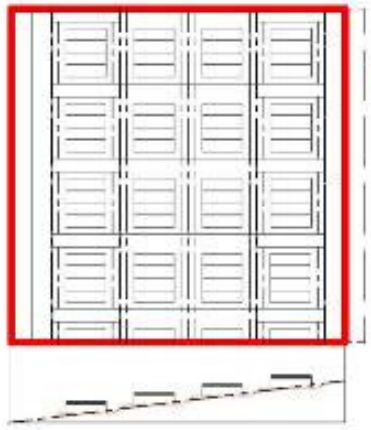
NARROW FRONTAGE SEMI-DETACHED UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 53 UNITS/HA ON GENTLE SLOPES TO 22 UNITS/HA ON VERY STEEP SLOPES.



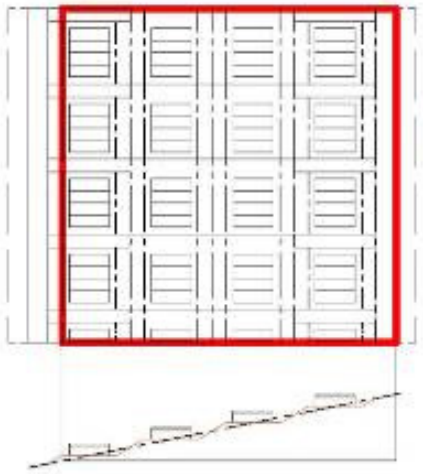
SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 40m²
SITE SIZE = 427m² - 579m²
DENSITY = 30.5/ha

SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 40m²
SITE SIZE = 588m² - 798m²
DENSITY = 22.7/ha

NARROW FRONTAGE HOUSING TYPOLOGY (ROW) - DENSITY COMPARISON

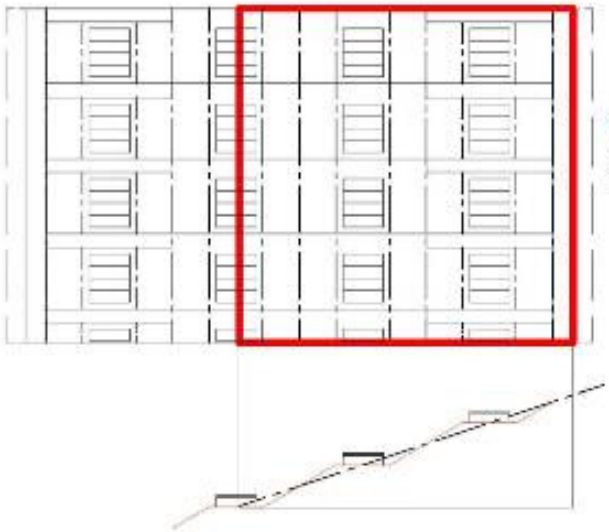


SLOPE = < 1:8 GENTLE
UNIT SIZE = 40m²
SITE SIZE = 379m² - 461m²
DENSITY = 72.3/ha



SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 40m²
SITE SIZE = 454m² - 553m²
DENSITY = 61.6/ha

NARROW FRONTAGE ROW HOUSE UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 72 UNITS/HA ON GENTLE SLOPES TO 31 UNITS/HA ON VERY STEEP SLOPES.

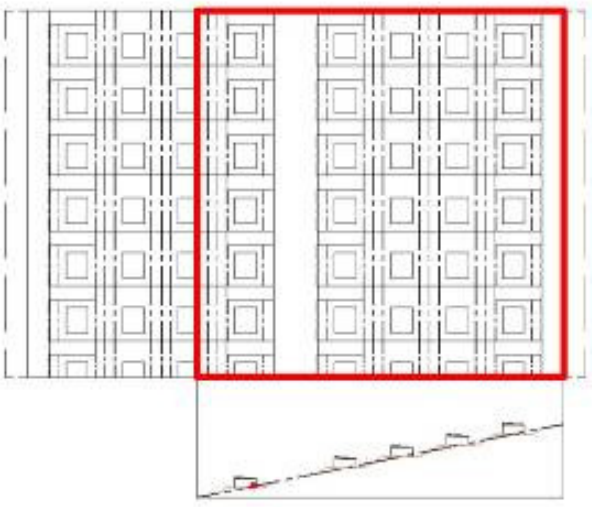


SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 40m²
SITE SIZE = 701m² - 855m²
DENSITY = 41.5/ha

SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 40m²
SITE SIZE = 966m² - 1175m²
DENSITY = 31/ha

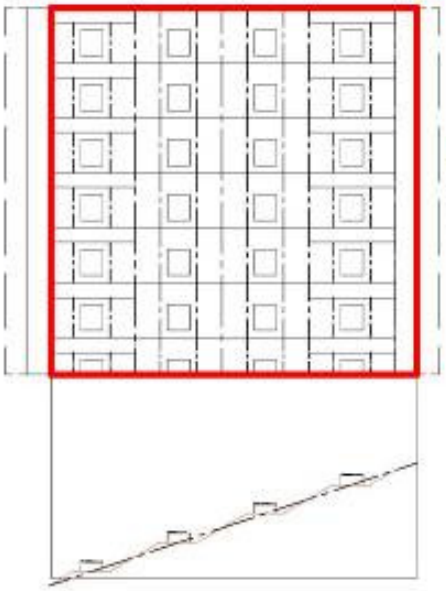
MEDIUM FRONTAGE HOUSING TYPOLOGY (DETACHED) - DENSITY COMPARISON

SLOPE = < 1:8 GENTLE
UNIT SIZE = 42m²
SITE SIZE = 125m² - 183m²
DENSITY = 41/ha

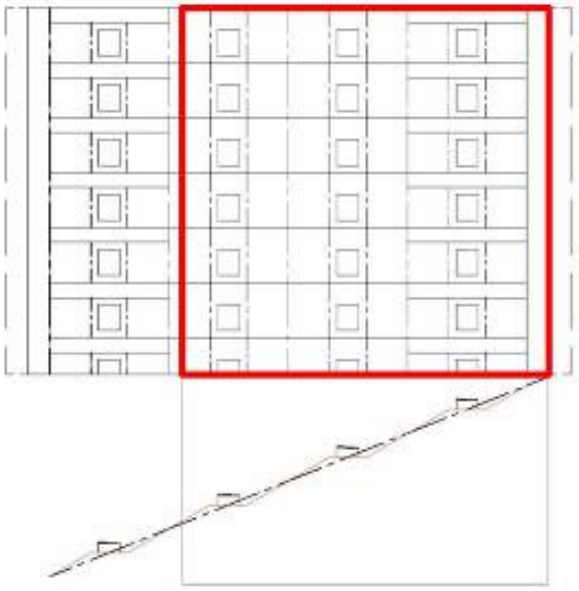


SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 42m²
SITE SIZE = 139m² - 212m²
DENSITY = 35.5/ha

MEDIUM FRONTAGE DETACHED UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 41 UNITS/HA ON GENTLE SLOPES TO 20 UNITS/HA ON VERY STEEP SLOPES.

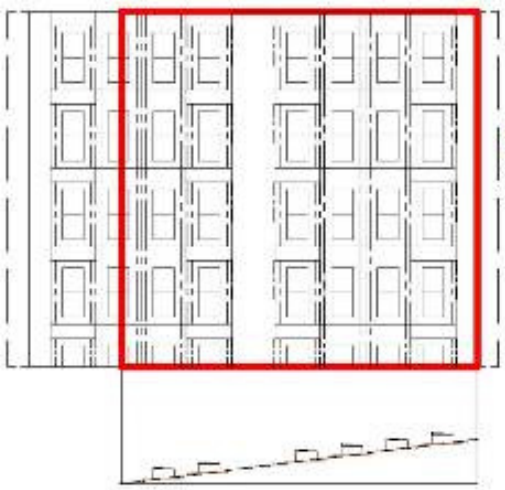


SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 42m²
SITE SIZE = 185m² - 253m²
DENSITY = 24/ha

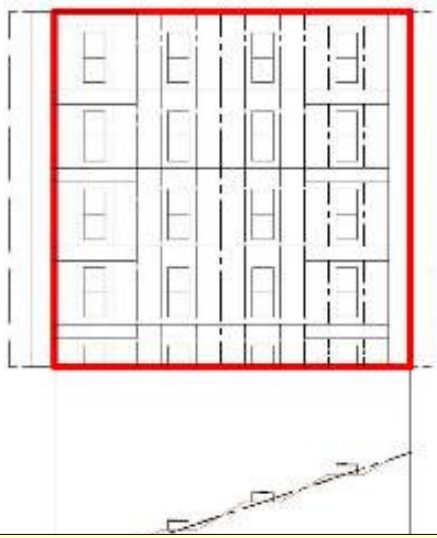


SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 42m²
SITE SIZE = 234m² - 319m²
DENSITY = 20/ha

MEDIUM FRONTAGE HOUSING TYPOLOGY (SEMI-DETACHED) - DENSITY COMPARISON



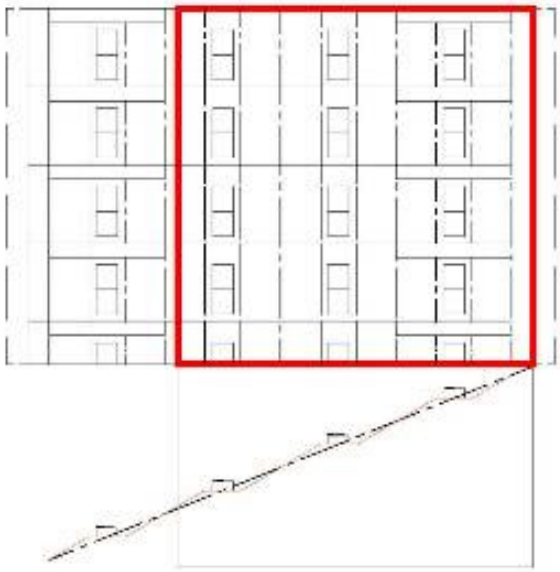
SLOPE = < 1:8 GENTLE
UNIT SIZE = 40m²
SITE SIZE = 230m² - 281m²
DENSITY = 57.14/ha



SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 40m²
SITE SIZE = 426m² - 521m²
DENSITY = 33.65/ha

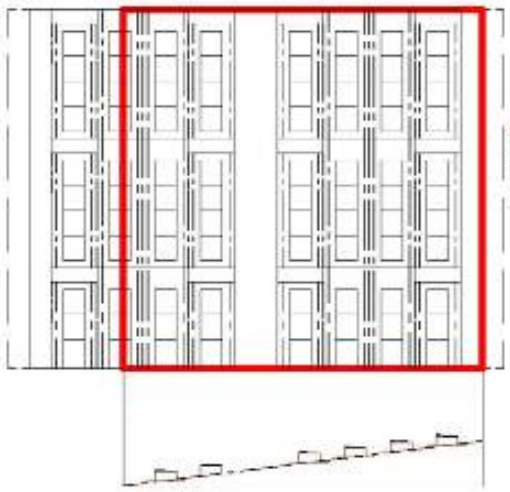
MEDIUM FRONTAGE SEMI-DETACHED UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 57 UNITS/HA ON GENTLE SLOPES TO 25 UNITS/HA ON VERY STEEP SLOPES.

SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 40m²
SITE SIZE = 275m² - 337m²
DENSITY = 49.32/ha

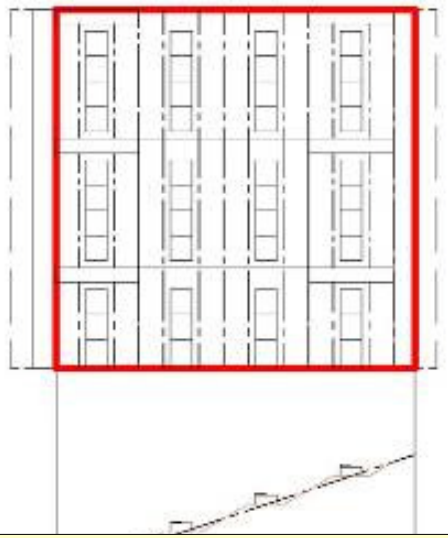


SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 40m²
SITE SIZE = 586m² - 716m²
DENSITY = 25.71/ha

MEDIUM FRONTAGE HOUSING TYPOLOGY (ROW) - DENSITY COMPARISON

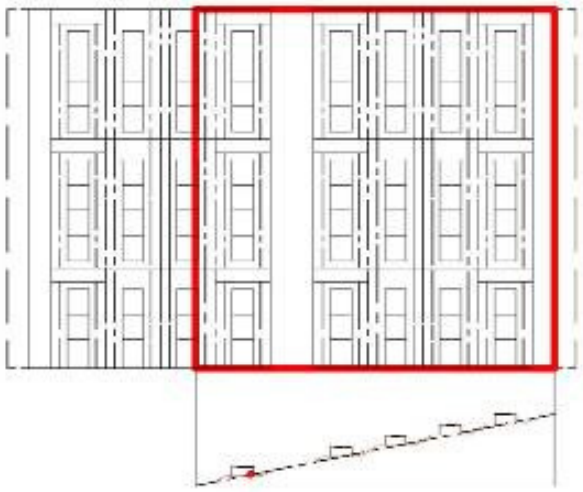


SLOPE = < 1:8 GENTLE
UNIT SIZE = 40m²
SITE SIZE = 408m² - 459m²
DENSITY = 69.84/ha

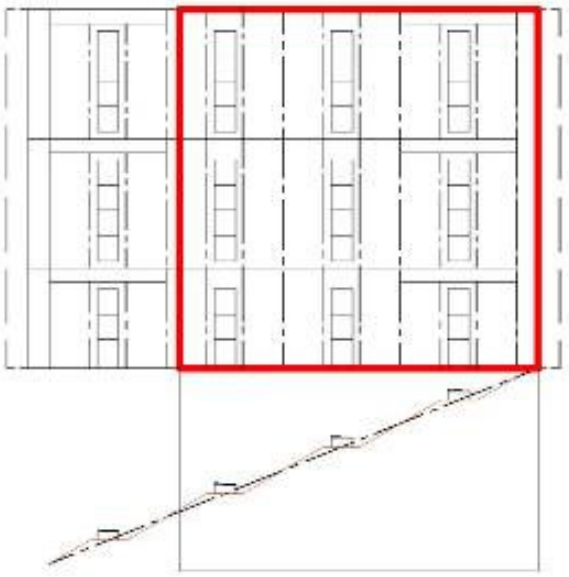


SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 40m²
SITE SIZE = 757m² - 852m²
DENSITY = 41.12/ha

MEDIUM FRONTAGE ROW HOUSE UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 69 UNITS/HA ON GENTLE SLOPES TO 25 UNITS/HA ON VERY STEEP SLOPES.

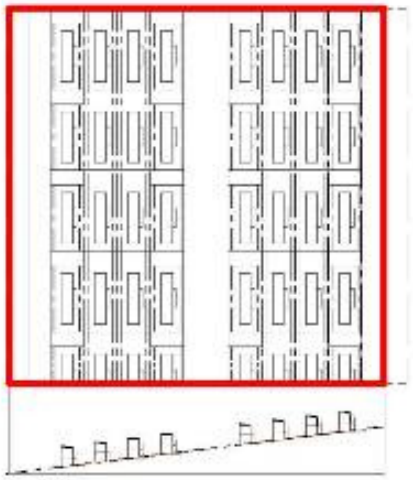


SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 40m²
SITE SIZE = 489m² - 551m²
DENSITY = 60.27/ha

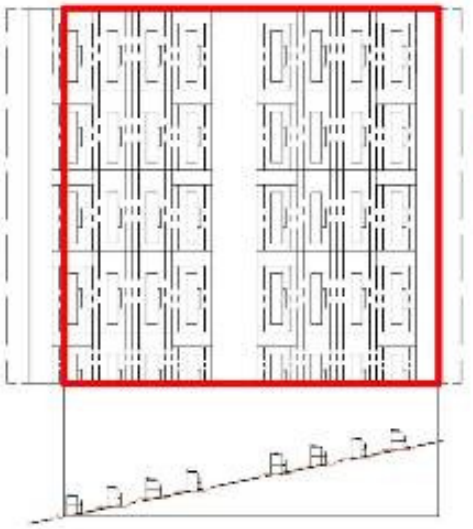


SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 40m²
SITE SIZE = 1042m² - 1172m²
DENSITY = 25.71/ha

WIDE FRONTAGE HOUSING TYPOLOGY (DETACHED) - DENSITY COMPARISON

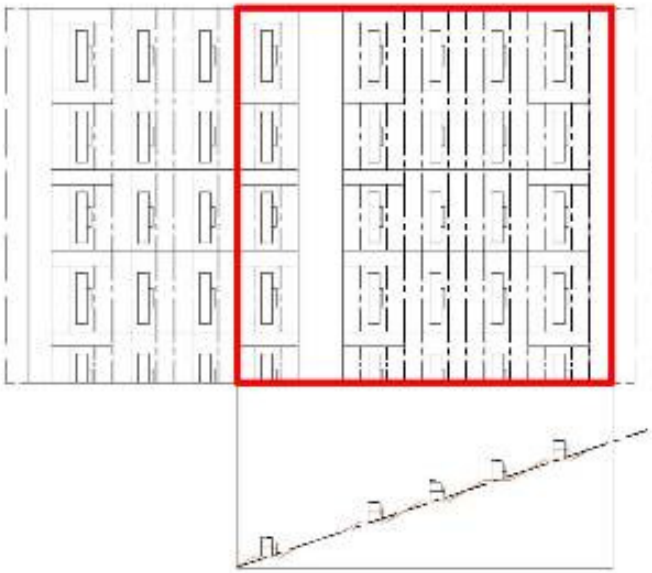


SLOPE = < 1:8 GENTLE
UNIT SIZE = 40m²
SITE SIZE = 157m² - 227m²
DENSITY = 38/ha

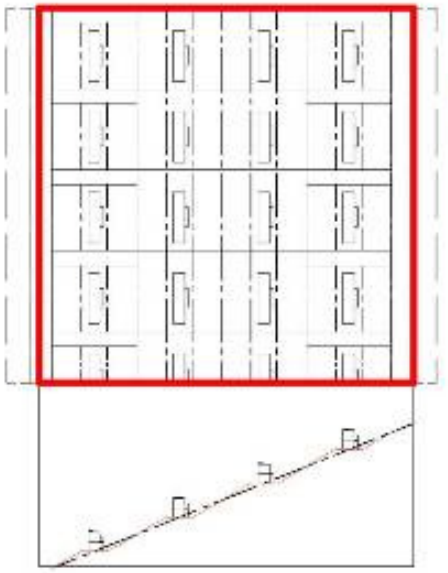


SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 40m²
SITE SIZE = 188m² - 259m²
DENSITY = 33/ha

WIDE FRONTAGE DETACHED UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 38 UNITS/HA ON GENTLE SLOPES TO 17 UNITS/HA ON VERY STEEP SLOPES.

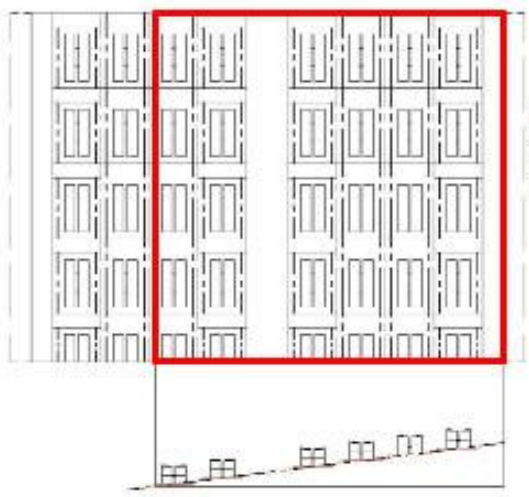


SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 40m²
SITE SIZE = 290m² - 356m²
DENSITY = 23/ha

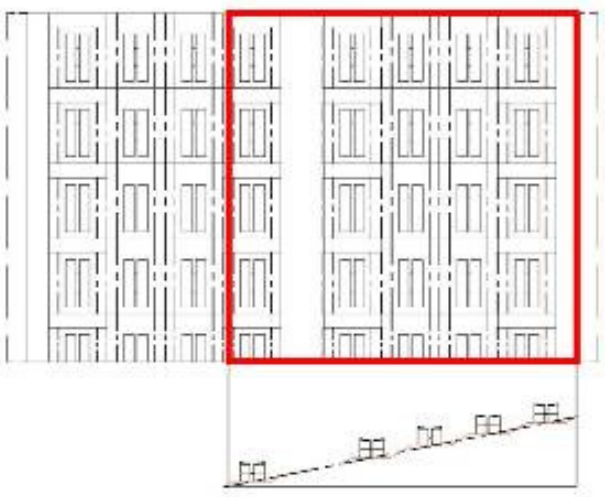


SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 40m²
SITE SIZE = 400m² - 490m²
DENSITY = 17.5/ha

WIDE FRONTAGE HOUSING TYPOLOGY (SEMI-DETACHED) - DENSITY COMPARISON

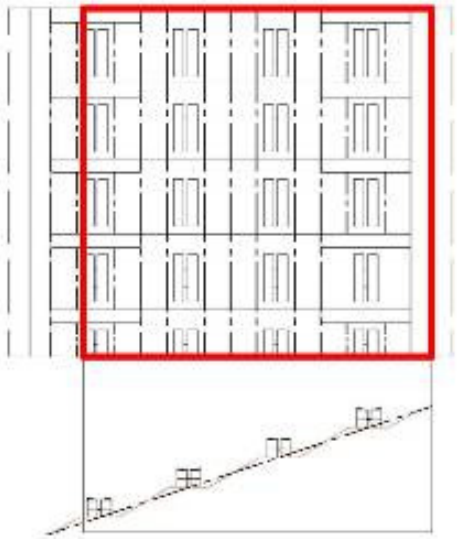


SLOPE = < 1:8 GENTLE
UNIT SIZE = 40m²
SITE SIZE = 245m² - 315m²
DENSITY =53/ha

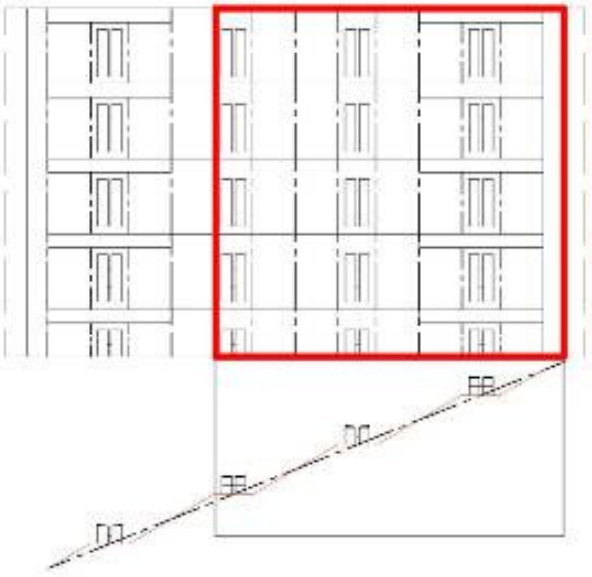


SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 40m²
SITE SIZE = 294m² - 346m²
DENSITY = 45/ha

WIDE FRONTAGE SEMI-DETACHED UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 53 UNITS/HA ON GENTLE SLOPES TO 24 UNITS/HA ON VERY STEEP SLOPES.

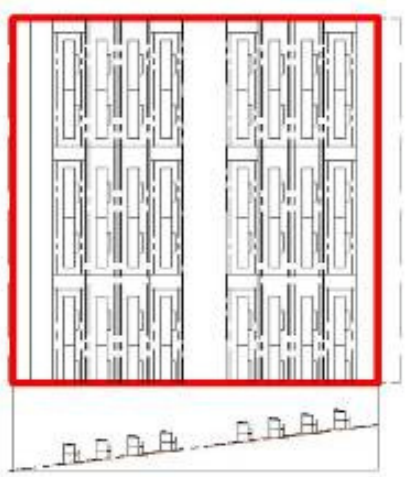


SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 40m²
SITE SIZE = 454m² - 557m²
DENSITY = 31/ha

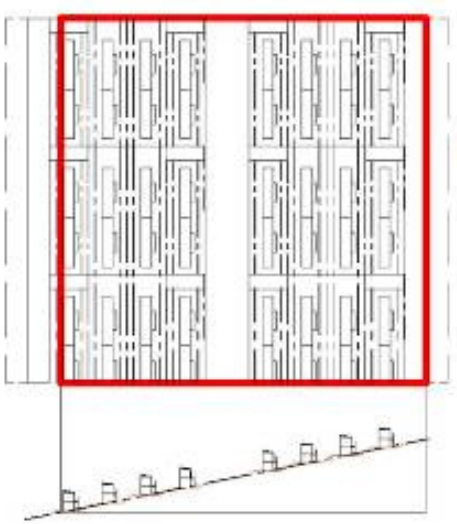


SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 40m²
SITE SIZE = 627m² - 769m²
DENSITY = 24/ha

WIDE FRONTAGE HOUSING TYPOLOGY (ROW) - DENSITY COMPARISON

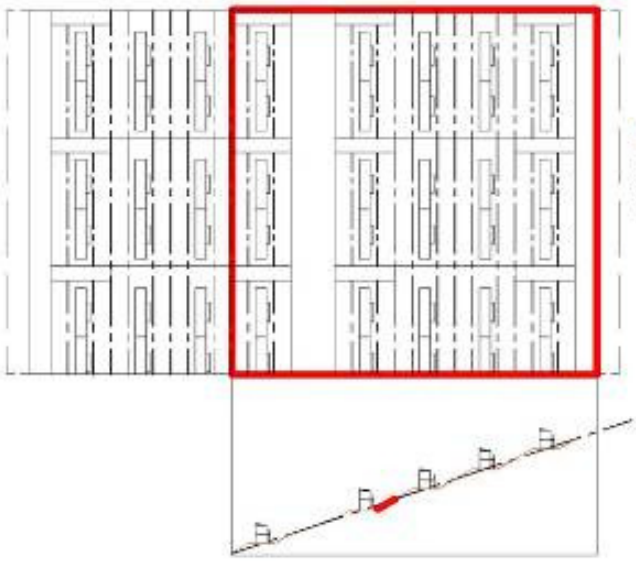


SLOPE = < 1:8 GENTLE
UNIT SIZE = 40m²
SITE SIZE = 277m² - 312m²
DENSITY = 46.3/ha

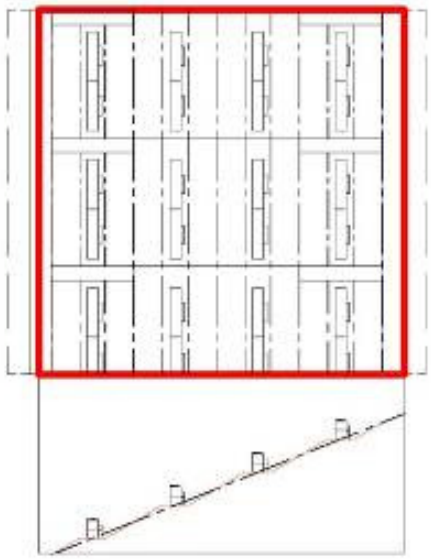


SLOPE = 1:5 - 1:8 MODERATE
UNIT SIZE = 40m²
SITE SIZE = 188m² - 259m²
DENSITY = 40/ha

WIDE FRONTAGE ROW- HOUSE UNITS ON NATURALLY REPOSED CUT TO FILL SITES ACHIEVE DENSITIES RANGING FROM APPROXIMATELY 53 UNITS/HA ON GENTLE SLOPES TO 24 UNITS/HA ON VERY STEEP SLOPES.

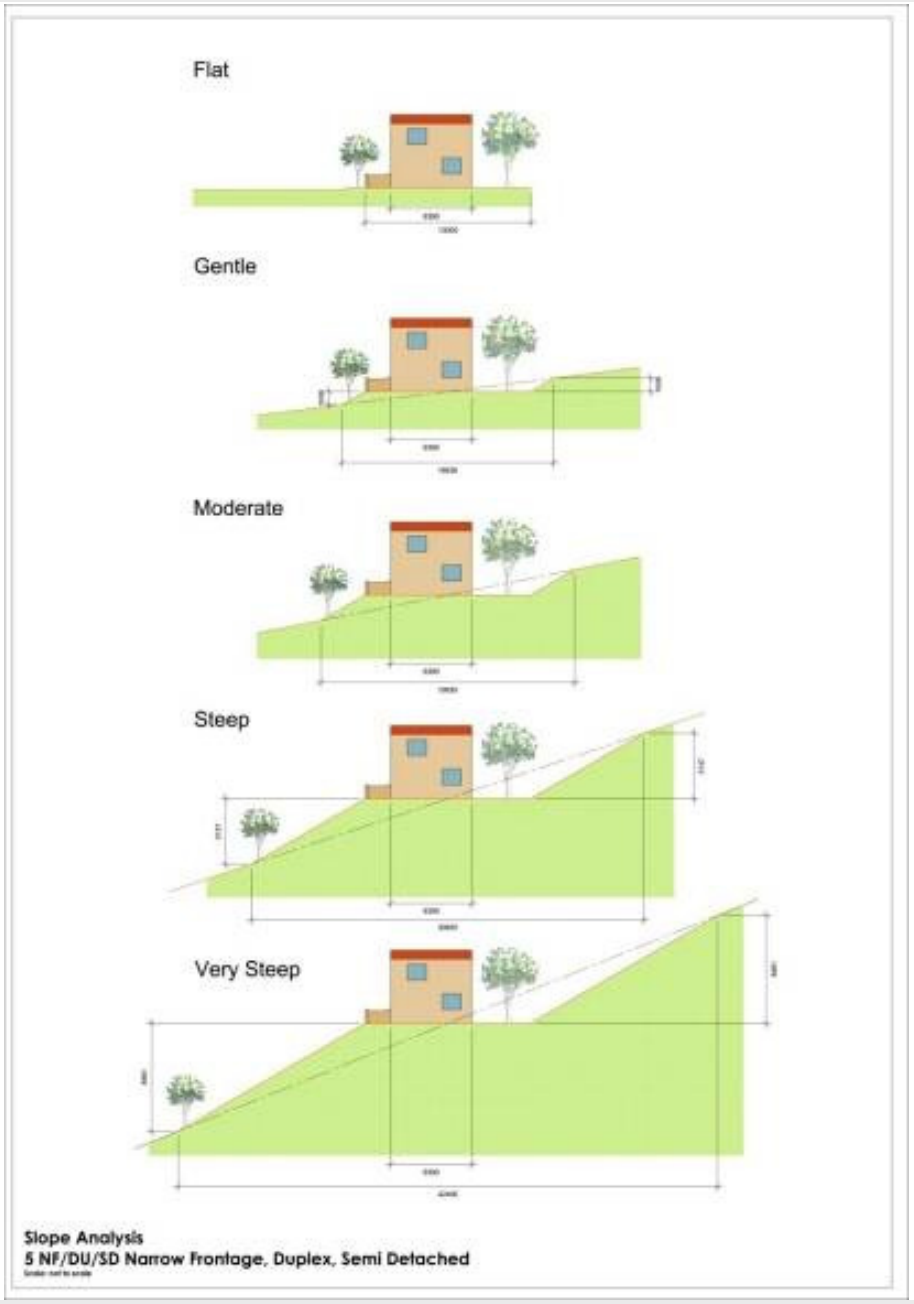


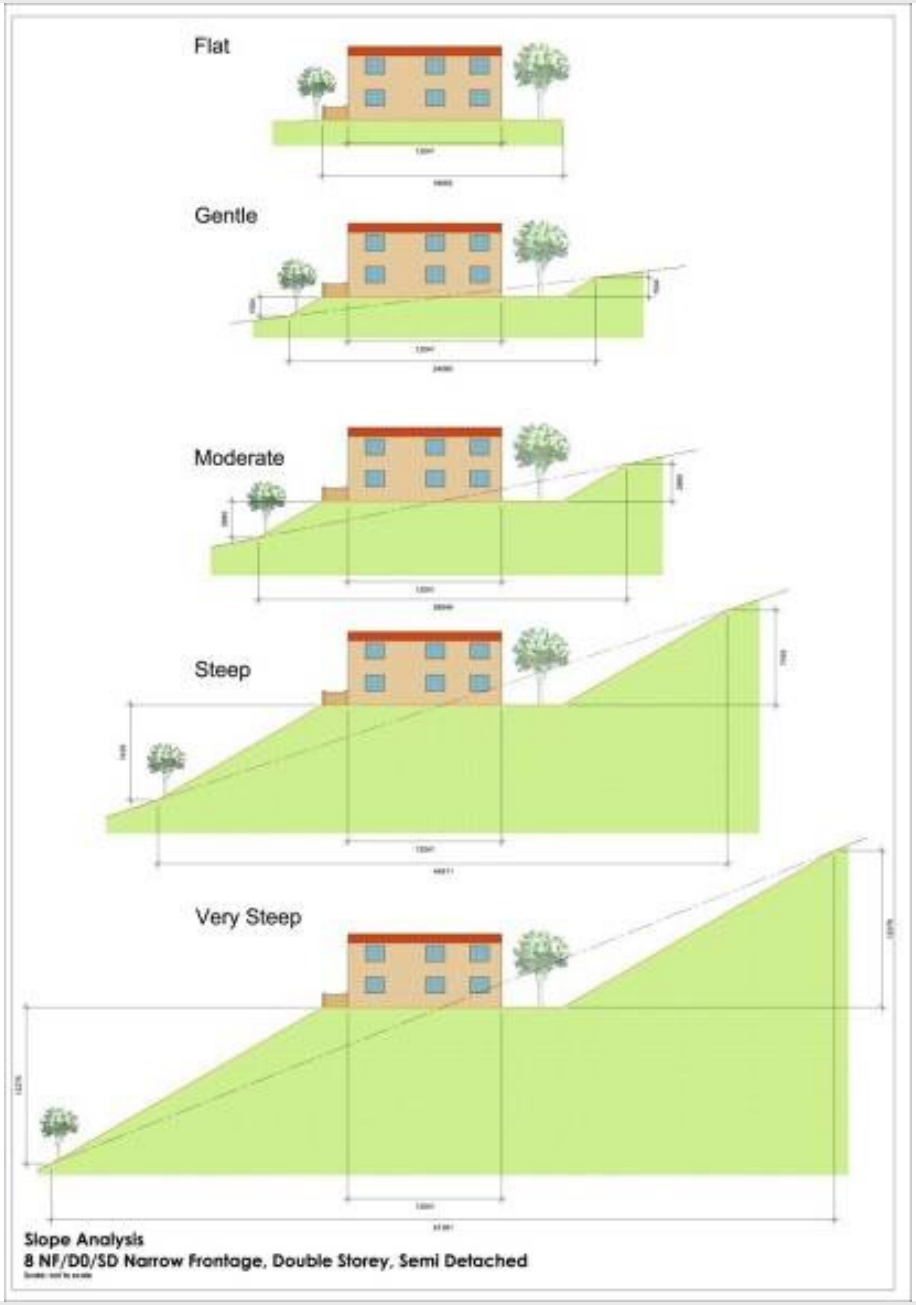
SLOPE = 1:3 - 1:5 STEEP
UNIT SIZE = 40m²
SITE SIZE = 290m² - 356m²
DENSITY =28.2.ha



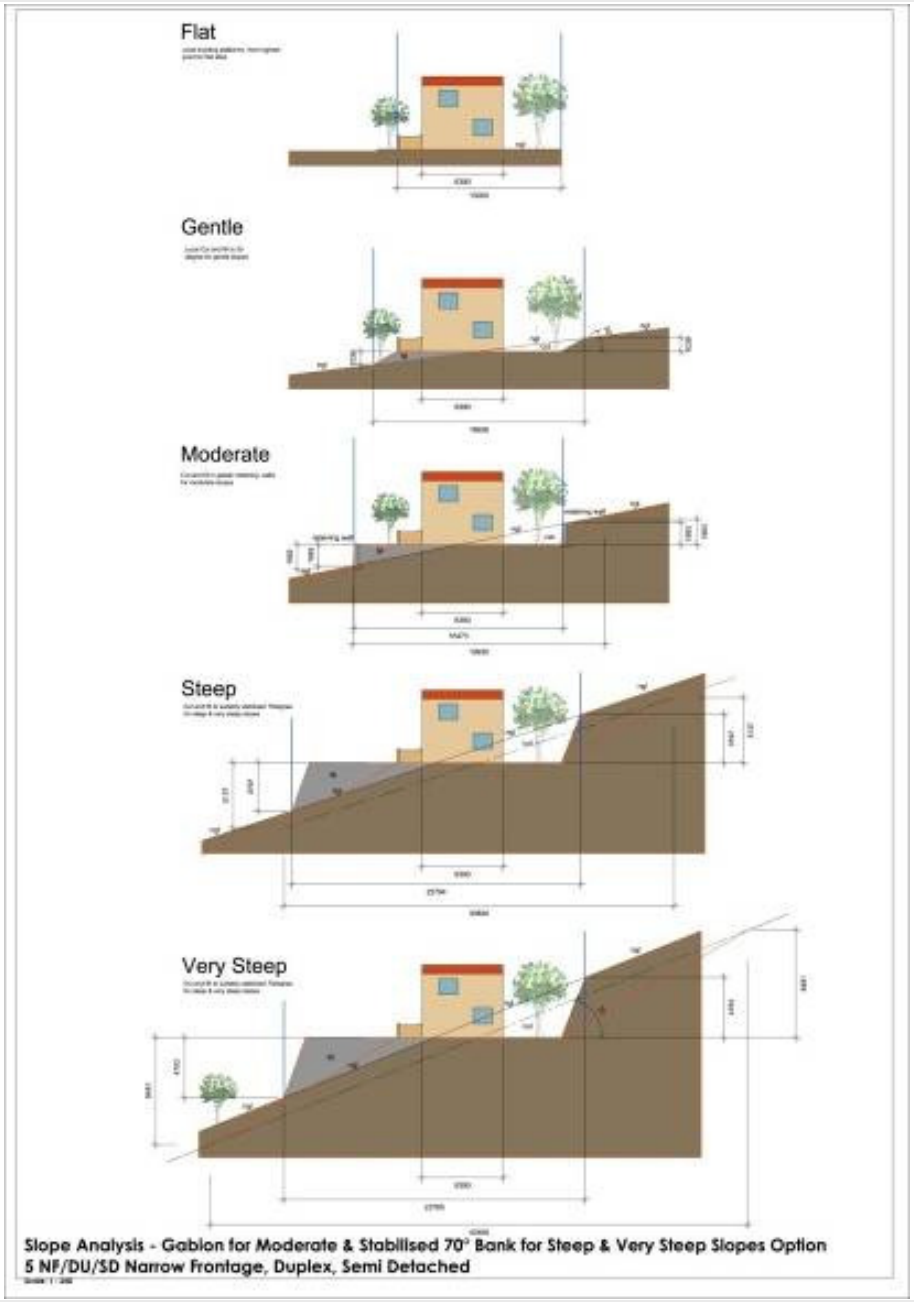
SLOPE = > 1:2.5 VERY STEEP
UNIT SIZE = 40m²
SITE SIZE = 400m² - 490m²
DENSITY = 21.4/ha

NARROW FRONTAGE (NATURALLY REPOSED SLOPE)

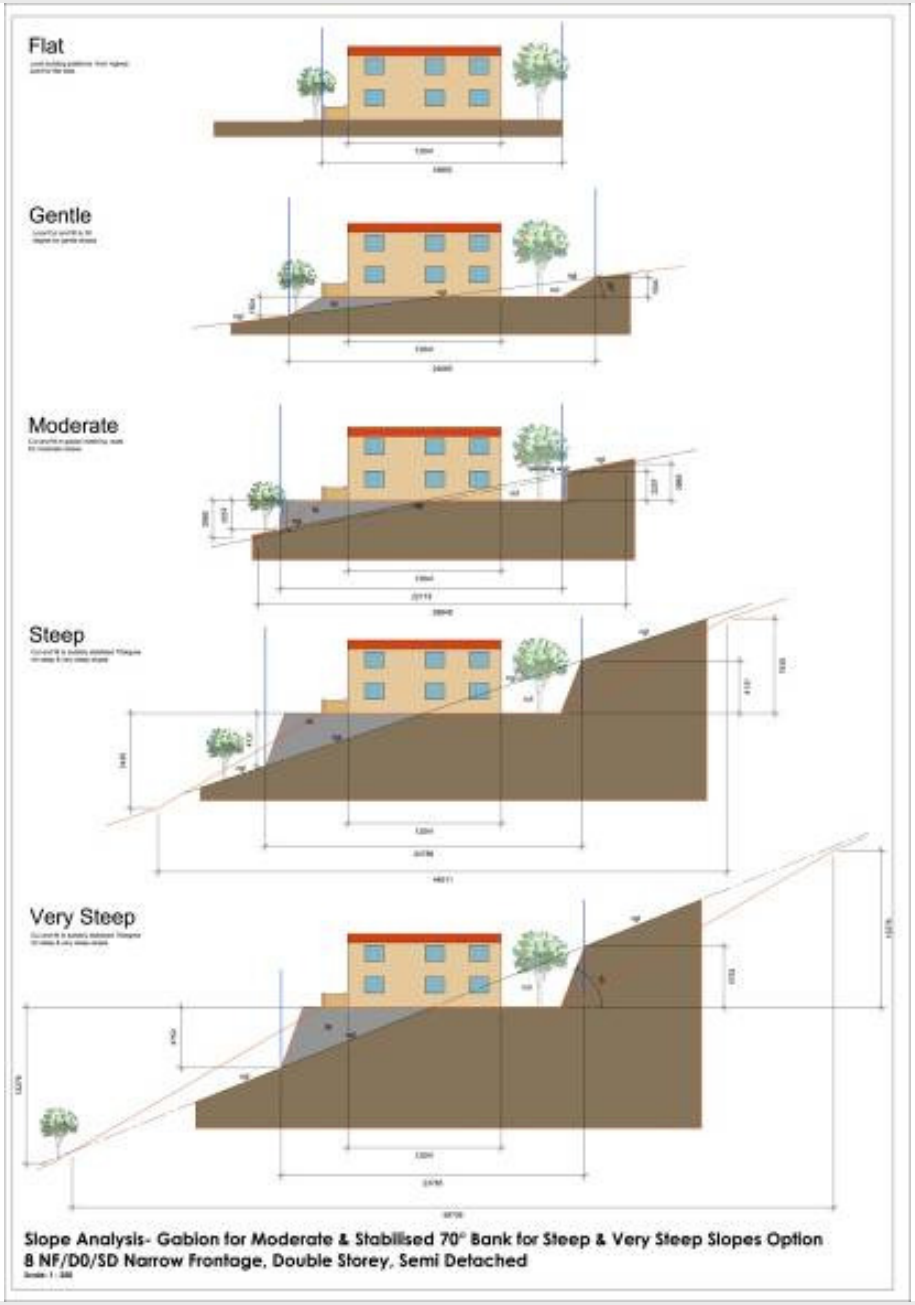




NARROW FRONTAGE (RETAINED SLOPES)

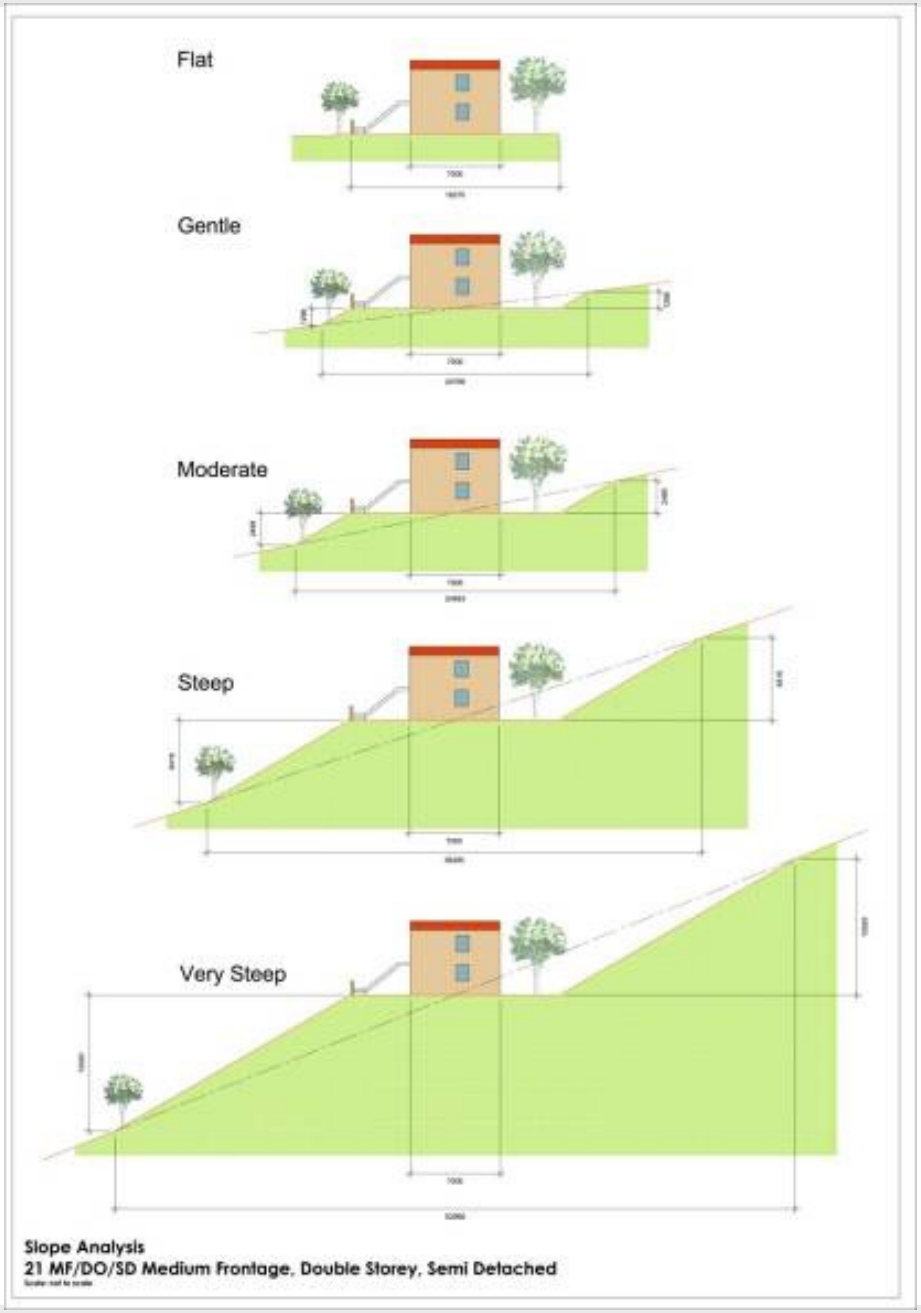


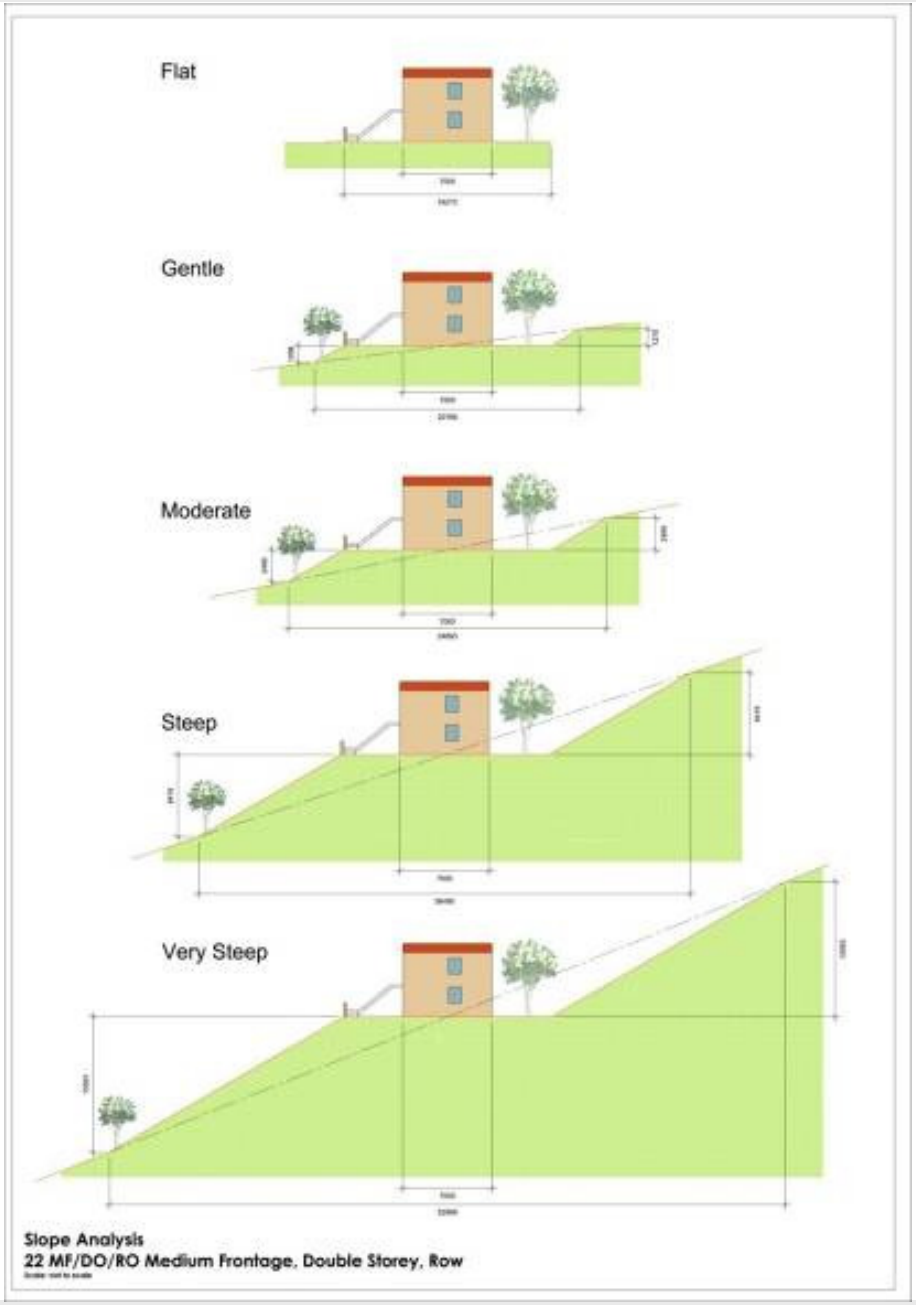
Slope Analysis - Gabion for Moderate & Stabilised 70° Bank for Steep & Very Steep Slopes Option
5 NF/DU/SD Narrow Frontage, Duplex, Semi Detached



Slope Analysis- Gabion for Moderate & Stabilised 70° Bank for Steep & Very Steep Slopes Option
8 NF/DD/SD Narrow Frontage, Double Storey, Semi Detached

MEDIUM FRONTAGE (NATURALLY REPOSED SLOPE)



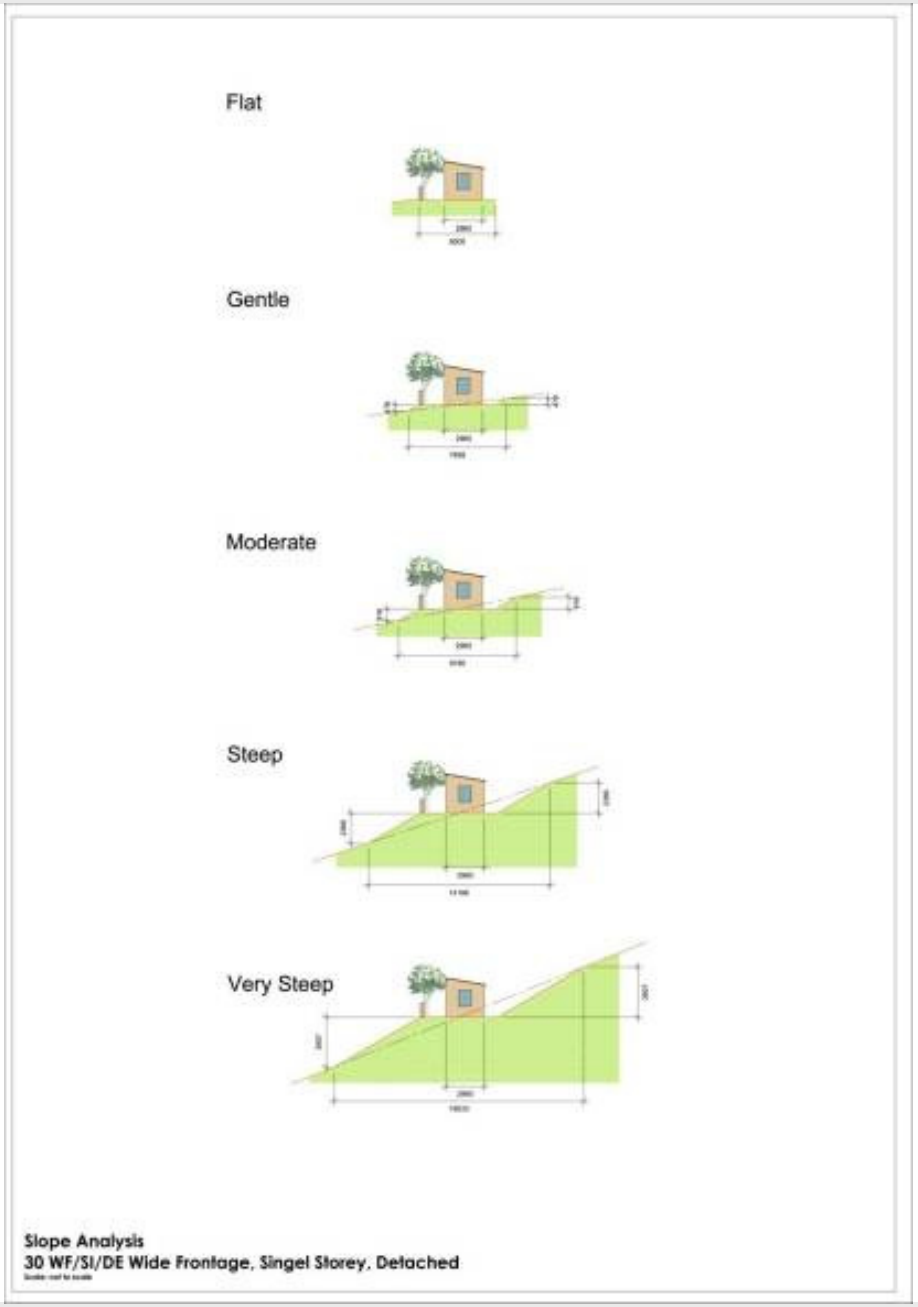


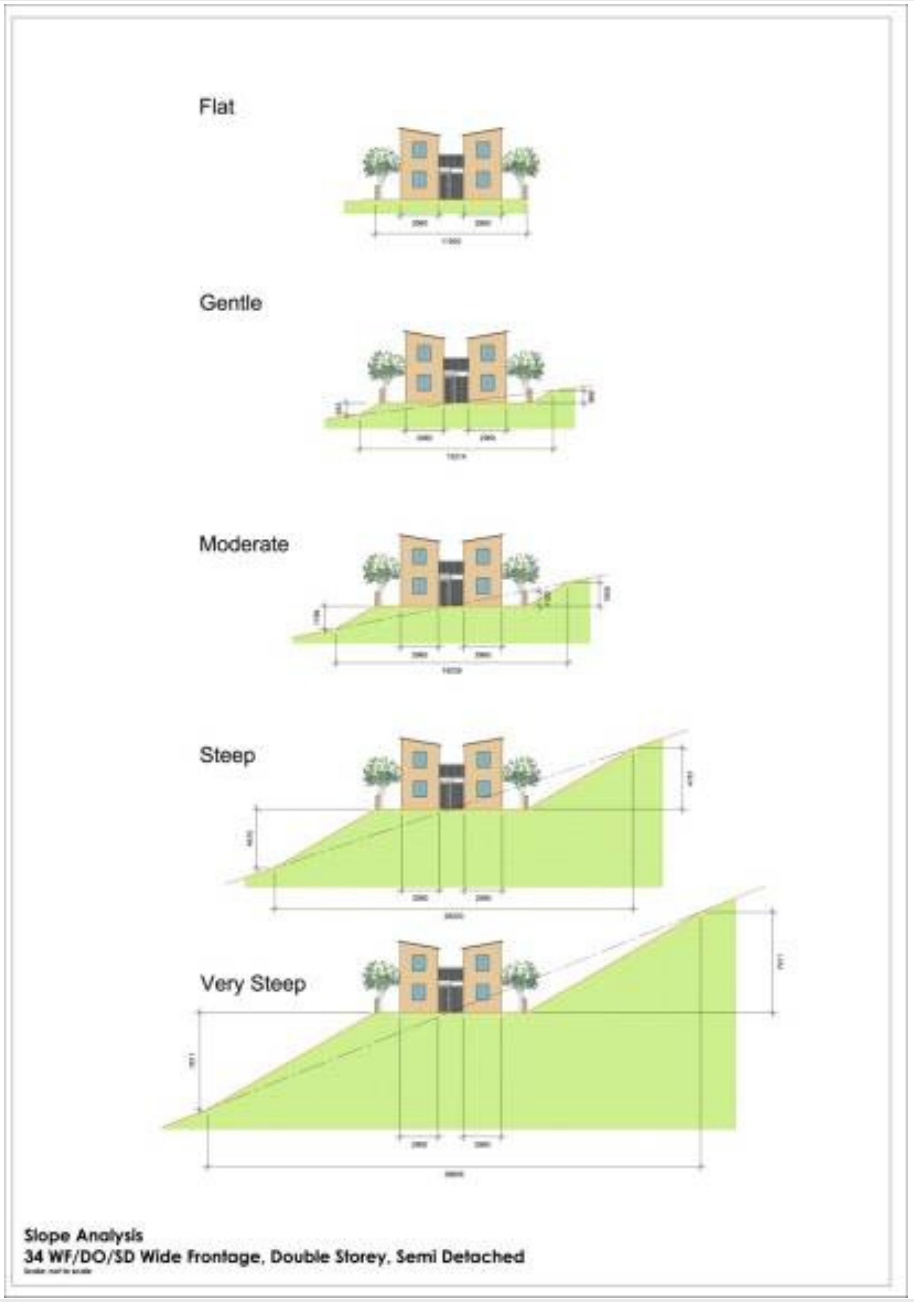
MEDIUM FRONTAGE (RETAINED SLOPES)

Slope Analysis - Gabion for Moderate & Stabilised 70° Bank for Steep & Very Steep Slopes Option
21 MF/DO/SD Medium Frontage, Double Storey, Semi Detached

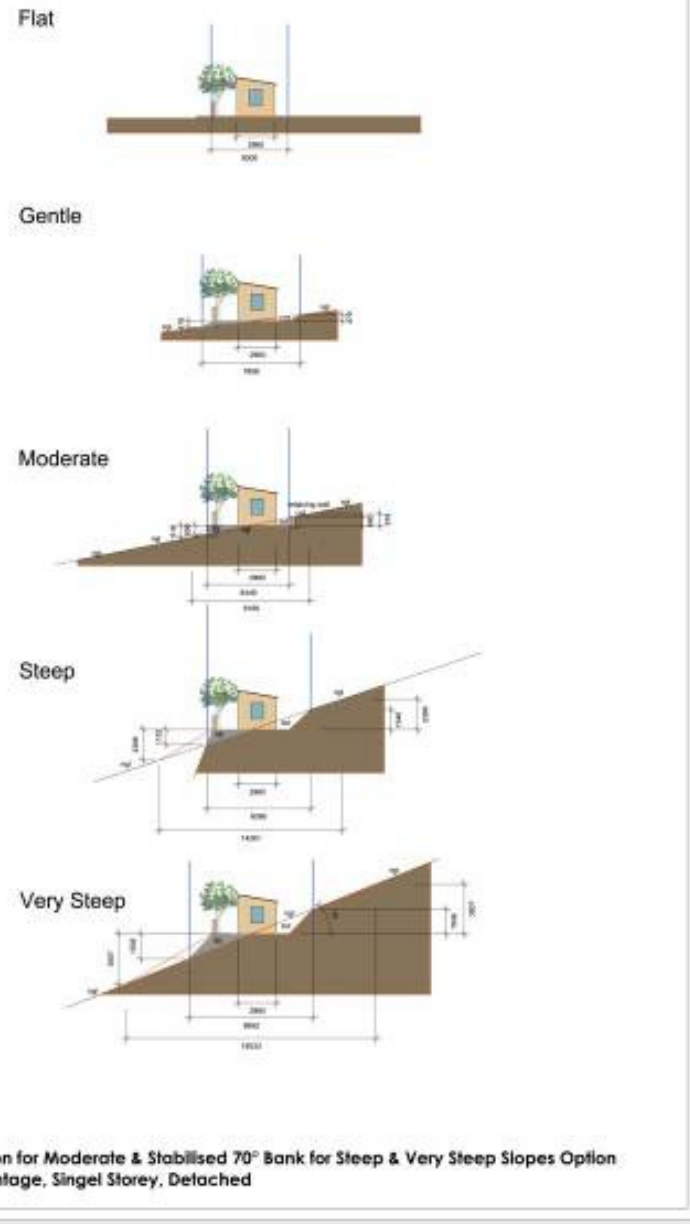
Slope Analysis
22 MF/DO/RO Medium Frontage, Double Storey, Row

WIDE FRONTAGE (NATURALLY REPOSED SLOPE)





WIDE FRONTAGE(RETAINED SLOPES)



Slope Analysis- Gabion for Moderate & Stabilised 70° Bank for Steep & Very Steep Slopes Option
30 WF/SI/DE Wide Frontage, Singel Storey, Detached

ALTERNATIVE BUILDING PLATFORMS

1. WITHIN THE BUILDING PLATFORM AREA THERE IS NO SAVING IN MOVING AWAY FROM THE CUT TO FILL SCENARIO. HERE WE CAN USE CONVENTIONAL FOUNDATIONS (EITHER STRIP FOOTINGS OR RAFT SLABS). THE COST OF PILES, FIN WALLS AND/OR FORMING A RETAINING WALL AS PART OF THE STRUCTURE WILL GENERALLY COST MORE THAN A CUT TO FILL EXERCISE.

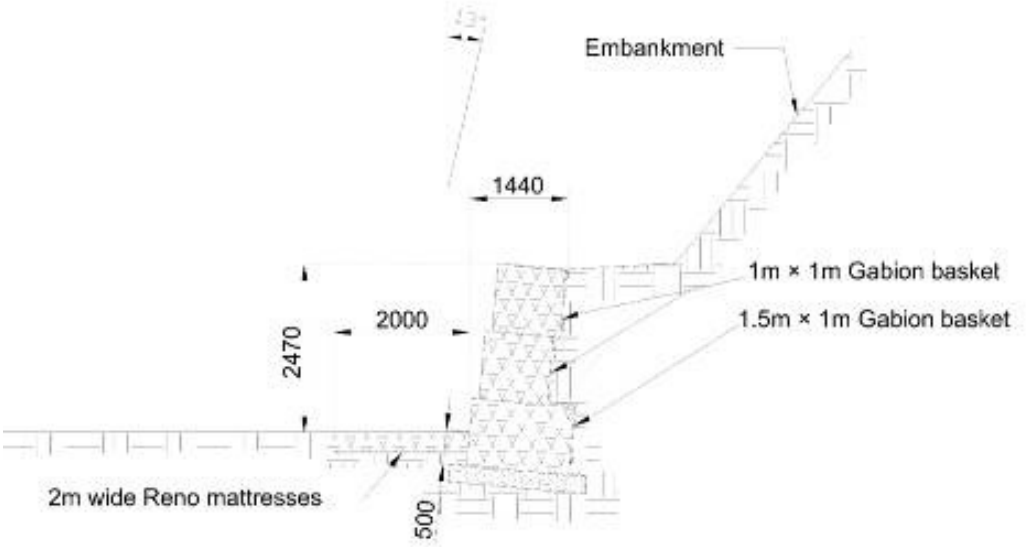
2. THE EXTENT OF THE CUT AND FILL SLOPES CAN BE REDUCED BY LOOKING AT A GABION WALL DETAIL. THIS CAN BE ALMOST VERTICAL (SAY 85 DEGREES). THE COST OF THE GABIONS WALLS CAN BE OFFSET BY THE POSSIBILITY OF ADDITIONAL UNITS.

3. NATURAL STABILITY OF CUT FACES IN ROCK CAN BE INVESTIGATED WHERE APPLICABLE.

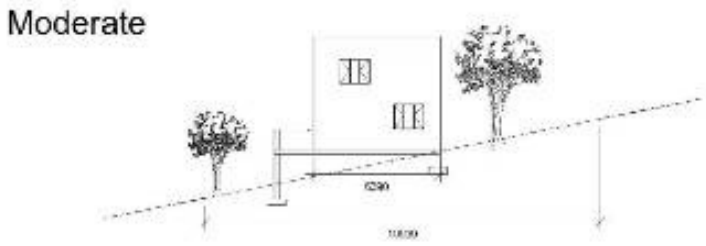
4. OTHER METHODS OF VERTICAL SLOPE STABILISATION WILL BE MORE EXPENSIVE THAN THE GABION WORKS.

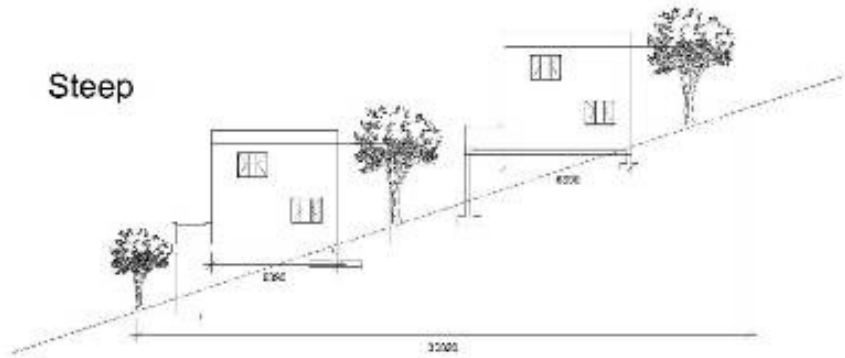
5. “OLD TYRE” RETAINING WALLS CAN BE USED UP TO APPROXIMATELY 2m HIGH ON A MAX 65° SLOPE BUT THIS TYPE OF WALL WILL LOOK UNSIGHTLY AND WILL MOVE AWAY FROM THE OBJECTIVES OF THE DEVELOPMENT.

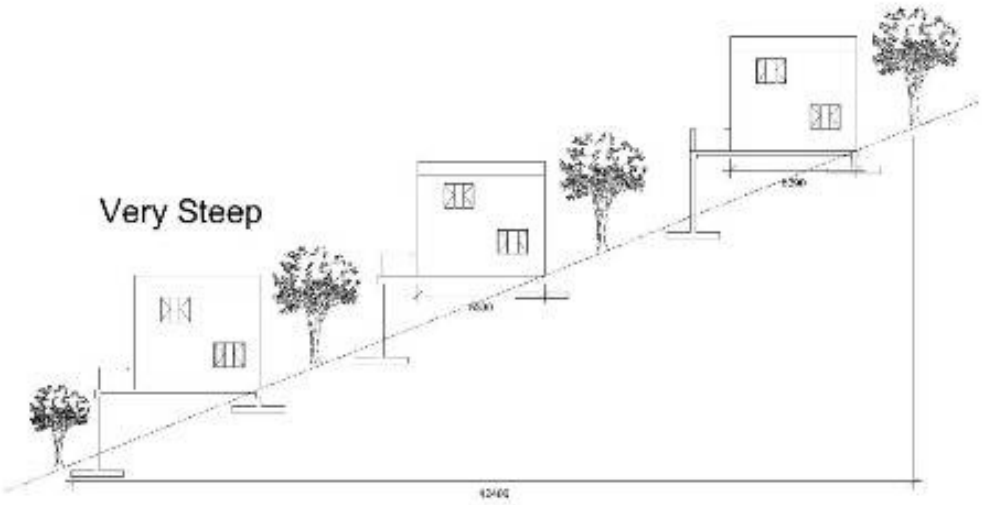
ALTERNATIVE BUILDING PLATFORMS



TYPICAL SECTION THROUGH
GABION BASKET







MATERIALS AND MINIMUM QUALITY LEVEL CONSIDERATIONS

SYNOPSIS

THIS SECTION AIMS TO ASSIST IN THE PROCESS OF SELECTING APPROPRIATE MATERIALS FOR A LOW-INCOME HOUSING PROJECT. IT SETS UP A SYSTEM FOR EVALUATING THE QUALITY OF MATERIALS THAT COULD BE USED IN THE CONSTRUCTION OF THE HOUSE TYPES. TYPICALLY COST IS THE MAIN CRITERIA USED IN IDENTIFYING LOW-INCOME HOUSING MATERIALS BUT WHAT IS SAVED IN THE UPFRONT CAPITAL COSTS OFTEN COMPROMISES OTHER ASPECTS OF THE PROJECT SUCH AS LONG TERM SERVICING AND MAINTENANCE COSTS. IN ADDITION CHEAP MATERIALS CAN ALSO COMPROMISE AESTHETICS, ENERGY EFFICIENCY, QUALITY OF THE URBAN ENVIRONMENT, DURABILITY ETC

QUALITY IN THIS SYSTEM IS DETERMINED BY SCORING A SET OF CRITERIA AGAINST A RANGE OF ALTERNATIVE MATERIALS FOR EACH COMPONENT OF THE BUILDING STRUCTURE.

THE ASSESSMENT CRITERIA ARE:

- AESTHETICS
- ENVIRONMENTAL QUALITY
- DURABILITY
- MAINTENANCE REQUIREMENTS
- BUILDABILITY
- ADAPTABILITY
- SUSTAINABLE MATERIAL OR PRACTICE
- COST
- NBR QUALIFICATION

MATERIALS ARE DIVIDED INTO SUPERSTRUCTURE MATERIALS AND FITTINGS AND FINISHES.
THE SUMMARY SHEET COMBINES ALL THE HIGHEST SCORING COMPONENTS TO IDENTIFY THE HIGHEST QUALITY COMBINATION OF MATERIALS. ALTHOUGH THE SCORING SYSTEM IS OFTEN SUBJECTIVE, IT IS INTENDED THAT THE COMBINATION OF THE CRITERIA WOULD PRODUCE REASONABLY RELIABLE RESULTS.

THIS SYSTEM IS INTENDED TO BE A LIVING DOCUMENT THAT SHOULD BE ADDED TO AND REFINED OVER TIME TO INCREASE ITS EFFECTIVENESS AND RELIABILITY.

MINIMUM QUALITY ASSESSMENT											
Item	**Alternatives**	**Aesthetics**	**Environmental Quality**	**Durability**	**Maintenance requirements**	**Buildability**	**Adaptability**	**Sustainabile material or practice**	**Cost**	**NBR Qualification**	**TOTAL**
						Ease of workmanship	*Additions by owner*		*High cost=1*	*Yes=5*	
									Low cost=5	*No=1*	
Criteria											
Very good	5										
Good	4										
Average	3										
Poor	2										
Very poor	1										
SUPERSTRUCTURE											
Earthworks											
Option 1	Cut and fill with 30 deg slope	3	3	5	5	5	5	5	5	5	41
Option 2	Cut and fill with stabilised 70 deg slope	3	3	5	4	4	5	5	4	5	38
Option 2	Retaining walls	5	4	4	5	2	2	4	3	5	34
Option 3	Platform and pillar	4	5	4	5	2	1	4	1	5	31
Foundations											
Option 1	Piles and caps	n/a	3	5	5	3	3	3	1	5	28
Option 2	Pad and beam	n/a							2	5	7
Option 3	Strip footings insitu	n/a	3	4	4	5	5	3	3	5	32
Option 4	Raft slabs	n/a	3	4	4	5	5	3	4	5	33
Option 5	Precast concrete planks	n/a	3	4	4	5	5	3	5	5	34
Exterior walls											
Option 1	230mm Claybrick masonry	5	5	5	5	5	5	5	3	5	43
Option 2	190mm Hollow Concrete blocks	3	3	3	3	5	4	3	4	5	33
Option 3	Single skin masonry with f/cement planks	5	4	3	3	4	4	3	3	5	34
Option 4	Timber frame with fibre cement planks	5	4	3	3	4	4	3	3	5	34
Option 5	Framed Sand bags	4	5	5	4	5	5	5	5	5	43
Option 6	Natural stone	5	5	5	5	3	4	3	3	5	40
Option 7	Straw bale on plinth wall	4	5	4	4	5	5	5	5	1	38
Option 8	Rammed earth on plinth wall	3	5	3	3	5	5	5	5	1	35
Exterior wall finishes											
Option 1	Exposed brickwork	3	3	5	5	4	5	5	4	5	39
Option 2	Bagged brickwork	3	3	3	3	4	5	4	4	5	34
Option 3	Sealed f/cem planking	3	3	4	3	4	5	3	3	5	33
Option 4	Painted f/cem planking	5	4	4	3	4	5	3	3	5	36
Option 5	Plaster and paint	5	4	4	4	4	5	3	3	5	37
Option 6	Mesh and plastered sandbags painted	5	4	4	4	4	5	4	3	5	38
Option 7	Natural stone finish pointed	5	5	5	5	3	5	5	5	5	43
Option 8	Slaked lime plaster	5	5	4	4	3	5	5	5	5	41
Option 9	Roughcast spatter plaster	5	5	5	5	4	5	4	5	5	43
Option 10	Mixed combinations	5	5	5	4	4	5	4	4	5	
Interior walls											
Option 1	115mm masonry	5	5	5	5	4	4	4	3	5	40
Option 2	90mm Hollow Concrete blocks	4	4	4	4	4	4	2	4	5	35
Option 3	Gypsum drywall on gms stud frame	3	3	3	3	4	4	2	4	5	31
Option 4	Plywoood drywall on gms stud frame	3	3	3	3	4	4	2	4	1	27

MATERIAL ASSESSMENT AND MINIMUM QUALITY LEVELS SUPERSTRUCTURE (con't)

Interior wall finishes											
Option 1	Fairface brickwork painted	3	4	4	4	4	4	5	5	5	38
Option 2	Bagged brickwork painted	3	3	4	4	4	4	4	4	5	35
Option 3	Plastered brickwork painted	5	4	4	4	4	4	3	3	5	36
Option 4	Rhino glide skimmed joint drywall painted	5	3	2	3	4	4	2	4	5	32
Slabs											
Option 1	90mm Concrete surface bed	n/a	3	4	4	4	5	2	4	5	31
Option 2	225mm Suspended insitu Concrete slab	n/a	3	4	4	3	3	2	3	5	27
Option 3	Beam and block supended slab	n/a	4	4	4	5	5	2	4	5	33
Option 4	Precast concrete plank suspended slab	n/a	4	4	4	5	5	2	4	5	33
Option 5	Precast concrete lintel suspended slab	n/a	4	4	4	5	5	2	4	5	33
Roofing support											
Option 1	Gum pole truss & SAP purlins	5	5	4	5	5	5	5	5	5	44
Option 2	Gum pole rafters & SAP purlins	5	5	4	5	5	5	5	5	5	44
Option 3	SAP Timber truss & SAP purlins	5	5	4	4	3	4	4	4	5	38
Option 4	SAP Timber rafters & SAP purlins	4	5	4	4	5	5	4	4	5	40
Option 5	Lightweight Steel truss & c/r steel purlins	4	3	4	3	3	3	3	5	5	33
Option 6	Steel rafters & c/r steel purlins	4	3	4	3	4	4	2	3	5	32
Roofing surface											
Option 1	Corrugated gm/s sheet	4	3	4	4	5	5	3	5	5	38
Option 2	Corrugated powder coated m/s sheet	5	5	5	5	5	4	3	3	5	40
Option 3	Corrugated fibre cement sheeting painted	5	5	5	4	5	5	5	5	5	44
Option 4	Cement tiles	5	5	5	4	4	5	2	3	5	38
Roof profile											
Option 1	Flat roof	4	4	n/a	n/a	3	5	n/a	2	5	23
Option 2	Mono-pitch	4	4	n/a	n/a	5	5	n/a	5	5	28
Option 3	Double pitch equal	4	4	n/a	n/a	4	5	n/a	4	5	26
Option 4	Double pitch unequal	4	4	n/a	n/a	4	5	n/a	4	5	26
Option 5	Vaulted sheet	3	3	n/a	n/a	5	2	n/a	5	5	23
Exterior doors											
Option 1	Steel frame & pressed steel door	2	2	3	3	5	4	3	4	5	31
Option 2	Steel frame & FLB&B timber door	3	3	3	3	4	4	4	3	5	32
Option 3	Timber frame & FLB&B timber door	5	5	4	3	5	4	5	3	5	39
Option 4	P.C Concrete frame & pressed steel door	2	2	3	3	3	3	3	3	5	27
Option 5	P.C Concrete frame & FLB&B timber door	4	4	4	3	3	3	4	3	5	33
Option 6	Aluminium frame & door (glazed)	5	5	5	5	4	4	2	2	5	37
Boundary walls											
Option 1	Masonry wall	5	5	5	5	3	3	3	3	5	37
Option 2	Pre-cast concrete panel	2	2	4	4	5	5	2	4	5	33
Option 3	Steel Palisade	4	4	4	3	4	4	3	3	5	34
Option 4	PVC coated diamond mesh wire fencing	3	3	3	5	5	5	4	5	5	38
Staircases and balconies											
Option 1	In-situ concrete	4	4	5	5	3	3	3	4	5	36
Option 2	Pre-cast concrete	4	4	5	5	5	2	3	4	5	37
Option 3	Steel	3	3	3	3	3	3	3	3	5	29

MINIMUM QUALITY ASSESSMENT											
Item	Alternatives	Aesthetics	Environmental Quality	Durability	Maintenance requirements	Buildability	Adaptability	Sustainabile material or practice	Cost	NBR Qualification	TOTAL
						Ease of workmanship	*Additions by owner*		*High cost=1*	*Yes=5*	
									Low cost=5	*No=1*	
FITTINGS AND FINISHES											
Interior doors											
Option 1	Steel frame & pressed steel door	2	2	4	3	5	n/a	2	5	5	28
Option 2	Steel frame & solid core timber door	3	3	4	3	5	n/a	4	4	5	31
Option 3	Timber frame & solid core timber door	5	5	4	3	5	n/a	5	3	5	35
Option 4	P.C Concrete frame & pressed steel door	2	2	4	3	4	n/a	2	3	5	25
Windows											
Option 1	Steel frame & steel window	3	3	5	4	4	n/a	3	5	5	32
Option 2	Timber frame & timber window	5	5	4	4	4	n/a	5	3	5	35
Option 3	P.C Concrete frame & steel window	3	3	5	4	4	n/a	3	4	5	31
Option 4	P.C Concrete frame & timber window	5	5	4	4	4	n/a	4	3	5	34
Option 5	Aluminium frame & window	5	5	5	5	4	n/a	2	2	5	33
Option 6	uPVC frame & window	3	3	3	4	4	n/a	2	3	5	27
Flooring											
Option 1	Timber floated slab	2	2	5	5	5	4	3	4	5	35
Option 2	Steel floated slab	4	4	5	5	4	4	3	4	5	38
Option 3	Screeded slab	4	4	5	5	4	4	3	3	5	37
Option 4	Screeded & painted slab	4	4	5	4	4	4	3	3	5	36
Option 5	Vinyl tiles	3	3	4	4	4	4	2	5	5	34
Option 6	Cork tiles	4	4	4	4	4	4	5	3	5	37
Option 7	Carpet tiles	4	4	3	3	4	4	3	5	5	35
Option 8	Carpet fitted	4	4	3	3	4	4	3	2	5	32
Option 9	Ceramic / Porcelain tiles	4	4	5	5	3	4	3	2	5	35
Option 10	Exposed aggregate slab external	4	4	5	5	3	4	3	3	5	36
Ceilings											
Option 1	6mm Gypsum on SAP branders	4	4	3	4	4	4	2	4	5	34
Option 2	6mm Fibre cement on SAP branders	4	4	5	5	4	4	3	4	5	38
Option 3	Plywood on SAP branders	4	4	5	4	4	4	3	3	5	36
Option 4	Masonite on SAP branders	3	3	2	2	4	4	3	4	5	30
Option 5	Reed on SAP branders	4	4	3	3	4	4	5	4	5	36
Bathroom fittings											
Option 1	Ceramic	5	5	4	4	4	n/a	3	3	5	33
Option 2	Stainless steel	4	4	5	5	4	n/a	3	2	5	32
Option 3	Perspex	5	5	3	3	4	n/a	3	3	5	31
Bathroom finishes											
Option 1	Porcelain or Ceramic tiles	5	5	5	5	5	3	3	2	5	38
Option 2	Plaster and paint	3	2	3	3	5	5	5	5	5	36
Option 3	Plaster & paint with tiled splashbacks	5	5	5	4	5	5	4	4	5	42
Kitchen fittings											
Option 1	MDF	4	4	3	3	3	4	3	3	5	32
Option 2	Melamine	4	4	2	2	3	4	3	4	5	31
Option 3	Steel	4	4	4	4	3	3	3	5	5	35
Option 4	None - Sink only owners to fit cupboards	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Kitchen finishes											
Option 1	Porcelain or ceramic tiles	5	5	5	5	5	3	3	2	5	38
Option 2	Plaster and paint	3	2	3	3	5	5	5	5	5	36
Option 3	Plaster & paint with tiled splashbacks	5	5	5	4	5	5	4	4	5	42
Landscaping											
Hard - Option 1	Paved pathways	5	5	5	5	3	3	3	3	5	37
Hard - Option 2	Exposed aggregate pathways	5	5	5	5	3	3	3	3	5	37
Soft - Option 1	1 Tree and shrubs	5	5	n/a	n/a	n/a	n/a	5	2	n/a	17
Soft - Option 1	1 Tree per plot	4	4	n/a	n/a	n/a	n/a	4	3	n/a	15
Soft - Option 3	None	2	2	n/a	n/a	n/a	n/a	2	4	n/a	10
Lawn - Option 1	Lawn	5	5	n/a	n/a	n/a	n/a	5	3	n/a	18
Lawn - Option 2	No Lawn - owners to plant as desired	1	2	n/a	n/a	n/a	n/a	2	5	n/a	10

MATERIAL ASSESSMENT AND MINIMUM QUALITY LEVELS

SUMMARY STATEMENT

SELECTED OPTIONS											
SUPERSTRUCTURE											
Earthworks											
Option 1	Cut and fill with 30 deg slope	3	3	5	5	5	5	5	5	5	41
Foundations											
Option 5	Precast concrete planks	n/a	3	4	4	5	5	3	5	5	34
Exterior walls											
Option 1	230mm Claybrick masonry	5	5	5	5	5	5	5	3	5	43
Option 5	Framed Sand bags	4	5	5	4	5	5	5	5	5	43
Exterior wall finishes											
Option 7	Natural stone finish pointed	5	5	5	5	3	5	5	5	5	43
Option 9	Roughcast spatter plaster	5	5	5	5	4	5	4	5	5	43
Interior walls											
Option 1	115mm masonry	5	5	5	5	4	4	4	3	5	40
Interior wall finishes											
Option 1	Fairface brickwork painted	3	4	4	4	4	4	5	5	5	38
Slabs											
Option 3	Beam and block supended slab	n/a	4	4	4	5	5	2	4	5	33
Option 4	Precast concrete plank suspended slab	n/a	4	4	4	5	5	2	4	5	33
Option 5	Precast concrete lintel suspended slab	n/a	4	4	4	5	5	2	4	5	33
Roofing support											
Option 1	Gum pole truss & SAP purlins	5	5	4	5	5	5	5	5	5	44
Option 2	Gum pole rafters & SAP purlins	5	5	4	5	5	5	5	5	5	44
Roofing surface											
Option 3	Corrugated fibre cement sheeting painted	5	5	5	4	5	5	5	5	5	44
Roof profile											
Option 2	Mono-pitch	4	4	n/a	n/a	5	5	n/a	5	5	28
Exterior doors											
Option 3	Timber frame & FLB&B timber door	5	5	4	3	5	4	5	3	5	39
Boundary walls											
Option 4	PVC coated diamond mesh wire fencing	3	3	3	5	5	5	4	5	5	38
Staircases and balconies											
Option 1	In-situ concrete	4	4	5	5	3	3	3	4	5	36
FITTINGS AND FINISHES											
Interior doors											
Option 3	Timber frame & solid core timber door	5	5	4	3	5	n/a	5	3	5	35
Windows											
Option 2	Timber frame & timber window	5	5	4	4	4	n/a	5	3	5	35
Flooring											
Option 2	Steel floated slab	4	4	5	5	4	4	3	4	5	38
Ceilings											
Option 2	6mm Fibre cement on SAP branders	4	4	5	5	4	4	3	4	5	38
Bathroom fittings											
Option 1	Ceramic	5	5	4	4	4	n/a	3	3	5	33
Bathroom finishes											
Option 3	Plaster & paint with tiled splashbacks	5	5	5	4	5	5	4	4	5	42
Kitchen fittings											
Option 3	Steel	4	4	4	4	3	3	3	5	5	35
Kitchen finishes											
Option 3	Plaster & paint with tiled splashbacks	5	5	5	4	5	5	4	4	5	42
Landscaping											
Hard - Option 1	Paved pathways	5	5	5	5	3	3	3	3	5	37
Hard - Option 2	Exposed aggregate pathways	5	5	5	5	3	3	3	3	5	37
Soft - Option 1	1 Tree and shrubs	5	5	n/a	n/a	n/a	n/a	5	2	n/a	17
Lawn - Option 1	Lawn	5	5	n/a	n/a	n/a	n/a	5	3	n/a	18

SYNOPSIS

THE NEXT SECTION ILLUSTRATE THE IMPACT USING ALTERNATIVE MATERIALS FOR THE BASIC SHELL CONSTRUCTION CAN HAVE ON AVAILABLE LIVING SPACE.

ALTHOUGH IT IS RECOGNISED THAT SOME OF THE FOLLOWING MATERIALS DO NOT CURRENTLY MEET NATIONAL BUILDING REGULATION OR HOUSING SUBSIDY REQUIREMENTS CONSIDERATION SHOULD BE GIVEN TO THEM BECAUSE OF THEIR COSTS, EASE OF CONSTRUCTION AND SPACE AVAILABILITY.

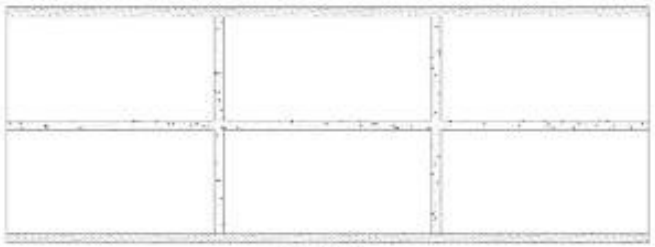
TRADITIONAL 230mm MASONRY WALL CONSTRUCTION FOR A 40m^2 MEDIUM FRONTAGE HOUSE (TAKEN AS EXTERIOR WALL MEASUREMENT) WOULD TYPICALLY REDUCE THE INTERIOR LIVING SPACE UP ABOUT 14% LEAVING A LIVING AREA OF ONLY 36m^2.

ALTERNATIVE MATERIALS ARE PROPOSED AND THEIR SPACE SAVING PROPERTIES ARE DETAILED.

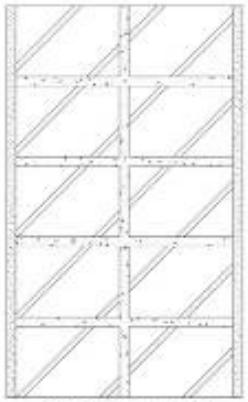
IT IS WORTH BEARING IN MIND HOWEVER THAT THE SAVINGS MADE ON THE WALL MATERIALS CAN BE USED TO INCREASE THE SIZE OF THE UNIT PROVIDING A BETTER LIVING SPACE. THE SIZE OF THE UNIT CAN BE ENLARGED ACCORDING TO BUDGET. THIS IS THE CASE IN SANDBAG CONSTRUCTION FOR EXAMPLE WHICH IS MUCH CHEAPER THAN MASONRY CONSTRUCTION ALLOWING A MUCH LARGER UNIT TO BE CONSTRUCTED.

MASONRY BRICK WALL – 230 mm

220 x 110 x 75mm bricks with 10mm mortar bond
Can be left with a brick finish or plastered for a smooth finish or other desired finish.



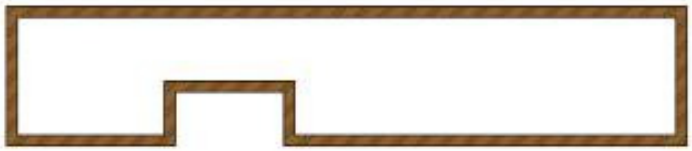
Plan 1:5



Cross Section 1:5

37m² interior dimension
43,6m² slab
15.2% loss of interior space

36m² interior dimension
42m² slab
14.3% loss of interior space

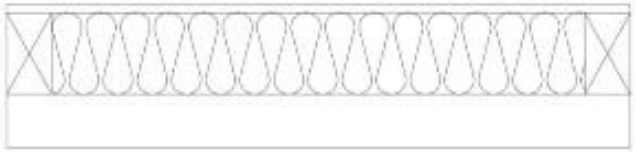


32m² interior dimension
40m² slab
20% loss of interior space

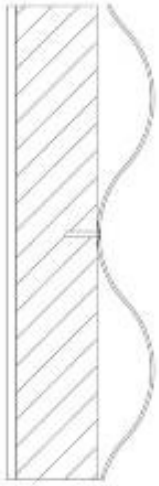
Masonry Building System - 230mm

CORRUGATED WALL SHEETING – 130 mm

Corrugated Iron Sheet nailed to 90 x 50mm timber stud
For regulated temperature control insulation is placed between timber studs and covered on the interior with a fibrous cement sheet



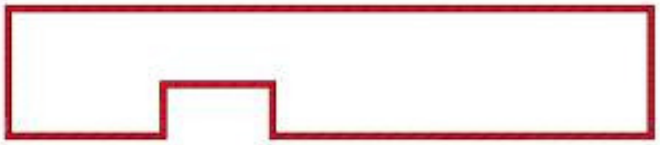
Plan 1:5



Cross Section 1:5

40m² interior dimension
43,6m² slab
8.3% loss of interior space

39m² interior dimension
42m² slab
7% loss of interior space

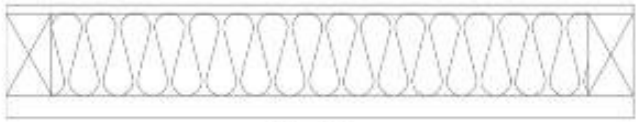


35m² interior dimension
40m² slab
12.5% loss of interior space

Corrugated Sheeting Building System - 130mm

TIMBER WALL CONSTRUCTION – 90 mm

25mm deep timber planks in specified lengths nailed to 90 x 50mm timber stud
For regulated temperature control insulation is placed between timber studs and covered on the interior with a fibrous cement sheet or timber planks depending on desired finish



Plan 1:5

Cross Section 1:5

41m² interior dimension
43,6m² slab
6% loss of interior space

40m² interior dimension
42m² slab
4.8% loss of interior space

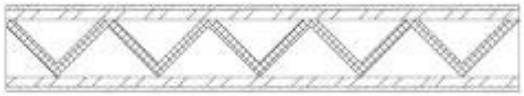
37m² interior dimension
40m² slab
7.5% loss of interior space

Timber Building System - 90mm

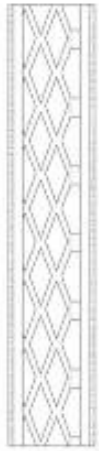
ROBUST STEEL SYSTEM – 80 mm

Walls comprised of zigzag perforated steel sheets tied together with reinforcing Y bars.

Cement slurry sprayed and plastered to specified finish (Bagwash/Plaster/ Rhinolite)



Plan 1:5



Cross Section 1:5

41m² interior dimension
43,6m² slab
6% loss of interior space

40m² interior dimension
42m² slab
4.8% loss of interior space

37m² interior dimension
40m² slab
7.5% loss of interior space

Robust Building System - 80mm

POLYCORE BUILDING SYSTEM – 60 mm

Polycore panel comprised of poly core sandwiched between 2 sheets of chromodek sheeting - colour to specification

Panel connected to slab via top hat section with apron flashing to waterproof at base

Plan 1:5

Cross Section 1:5

42m² interior dimension
43,6m² slab
3.7% loss of interior space

41m² interior dimension
42m² slab
2.4% loss of interior space

38m² interior dimension
40m² slab
5% loss of interior space

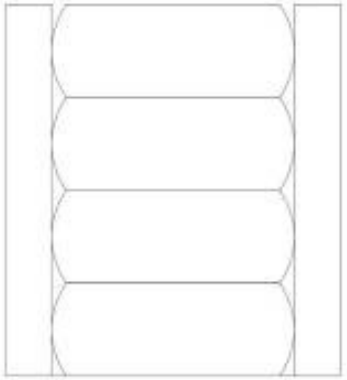
Polycore Building System - 60mm

SANDBAG WALL CONSTRUCTION – 400 mm

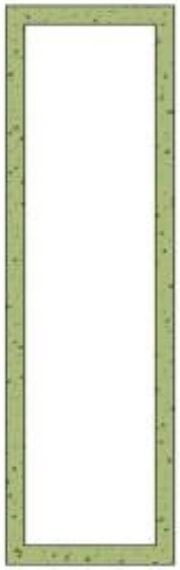
400 x 400mm woven hessian/polypropylene bags filled with sand or soil stacked upon one another within a timber or steel frame.

Plastered in specified finish

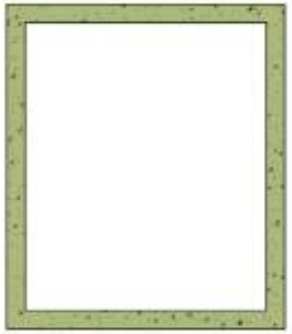
Plan 1:5



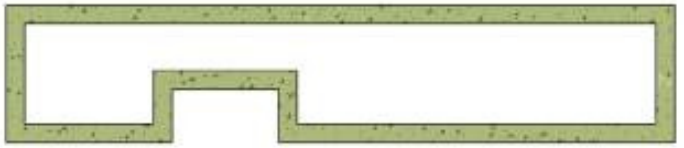
Cross Section 1:5



32m² interior dimension
43,6m² slab
26.6% loss of interior space



32m² interior dimension
42m² slab
24% loss of interior space



26m² interior dimension
40m² slab
35% loss of interior space

Sandbag Building System - 400mm

SERVICING AND SUSTAINABILITY CONSIDERATIONS

SYNOPSIS

THIS SECTION ILLUSTRATES VARIOUS OPTIONS AVAILABLE FOR CONSIDERATION IN SERVICING HOUSING UNITS AND IMPROVING THEIR ENERGY EFFICIENCY. THE OPTIONS FOR CONSIDERATION ARE:

- PROVIDING MUNICIPAL CONNECTIONS ONLY
- PROVIDING ENERGY EFFICIENT SYSTEMS OR
- A COMBINATION OF BOTH

IT IS PROPOSED THAT SERVICE CORES BE MANUFACTURED OFF-SITE, AND THEN INSTALLED AS WALL PANELS INTO THE UNIT AND CONNECTED ON-SITE. THIS APPROACH TO SERVICING A TYPICAL UNIT CAN REDUCE COST, TIME AND ON–SITE EXPERTISE REQUIRED.

SEPARATE PANELS FOR WATER AND SEWER, ELECTRICITY AND WASTE DISPOSAL FACILITIES CAN BE MANUFACTURED BY DIFFERENT SERVICE PROVIDERS AND DELIVERED AND INSTALLED AT THE APPROPRIATE TIME DURING THE CONSTRUCTION PERIOD. PANELS ARE DESIGNED TO FIT ONTO SMALL TRUCKS AND REQUIRE NO SPECIAL RIGGING OR VEHICLES TO DELIVER.

THE FOLLOWING DIAGRAMS ILLUSTRATE THE ABOVE CONCEPT FIRSTLY, LIMITED TO ONLY MUNICIPAL CONNECTIONS AND SECONDLY, AS SUPPLEMENTARY SUSTAINABLE ENERGY EFFICIENT SYSTEMS. THE MUNICIPAL CONNECTIONS IN THE SECOND CASE ARE RETAINED AS BACK-UP THAT COULD BE MANUALLY OR AUTOMATICALLY SWITCHED OVER. THE ENERGY EFFICIENT SYSTEMS INCLUDE:

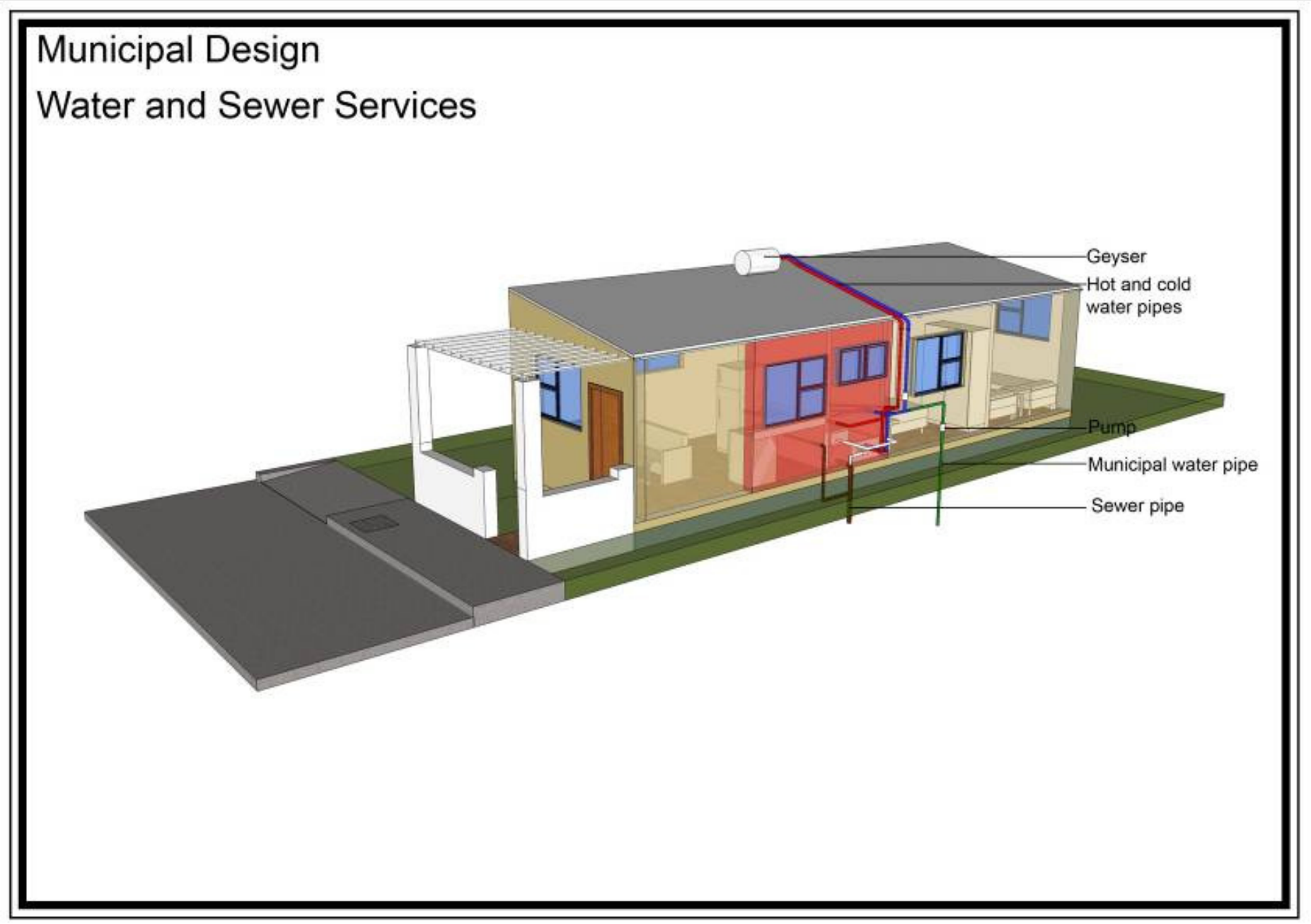
- WATER: RAIN WATER HARVESTING TANKS
- SEWER: SEPTIC TANKS (AEROBIC OR ANAEROBIC) OR PACKAGE PLANTS
- POWER: SOLAR GEYSERS, SOLAR PANELS, GAS CONVERTERS, DOMESTIC WIND TURBINES
- WASTE DISPOSAL: COMPOST HEAPS, RECYCLABLE COLLECTION BINS

ALTHOUGH ENERGY EFFICIENT SYSTEMS HAVE HIGH UP-FRONT COSTS, THEIR LONG TERM OPERATIONAL COSTS ARE CONSIDERABLY REDUCED.

SERVICING CONSIDERATIONS

Municipal Design

Electrical

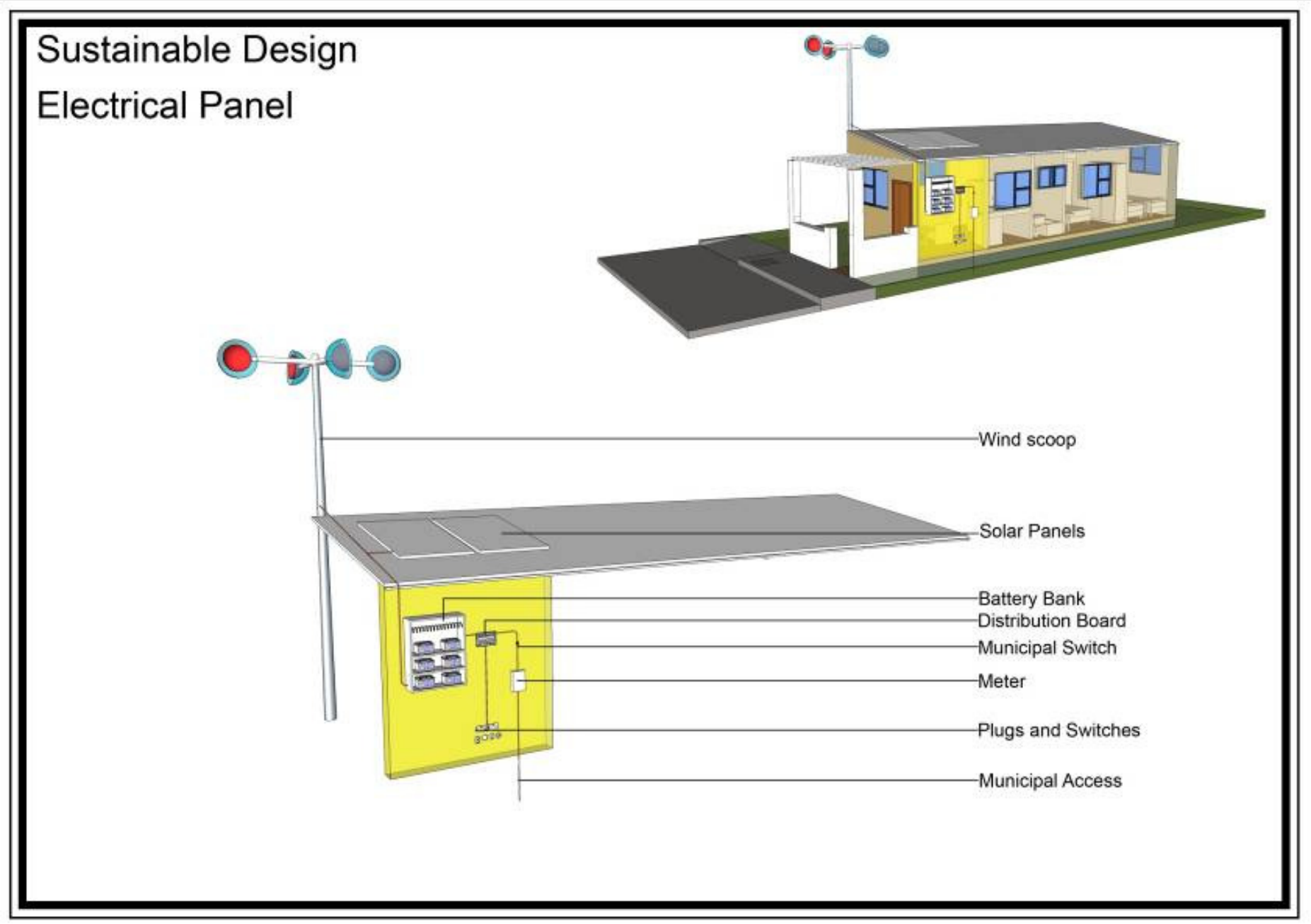

Municipal Design
Water and Sewer Services
Geyser
Hot and cold water pipes
Pump
Municipal water pipe
Sewer pipe

Municipal Design

Waste Disposal

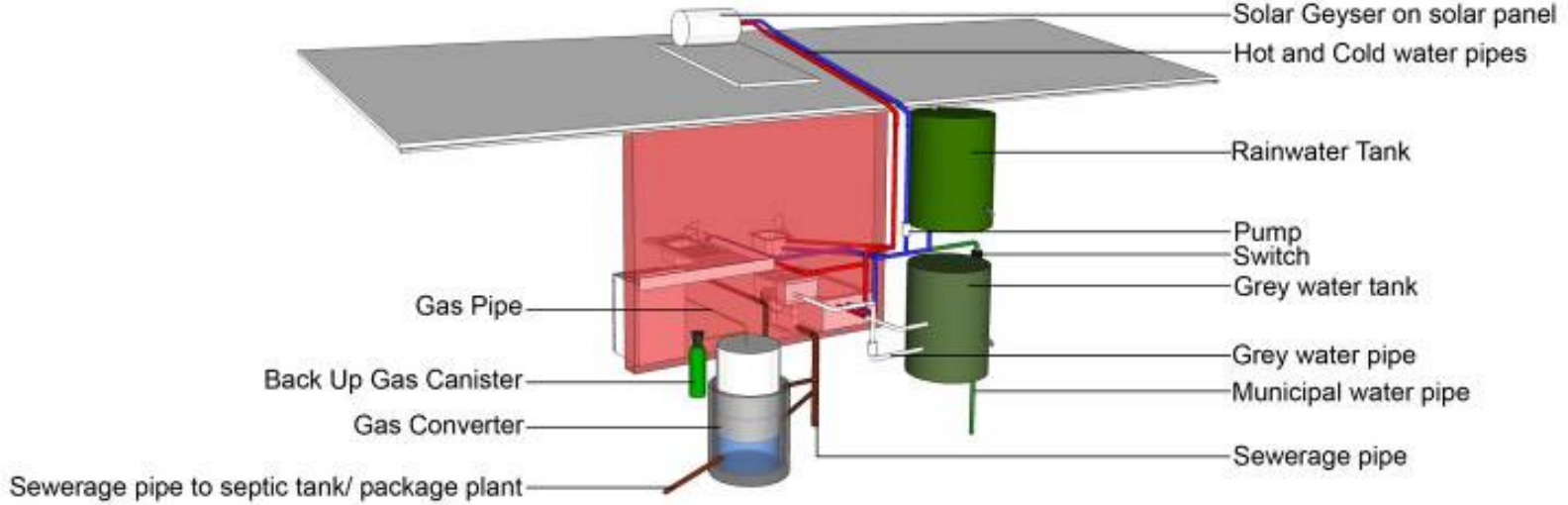
Municipal Design

Combined


Sustainable Design
Electrical Panel
Wind scoop
Solar Panels
Battery Bank
Distribution Board
Municipal Switch
Meter
Plugs and Switches
Municipal Access

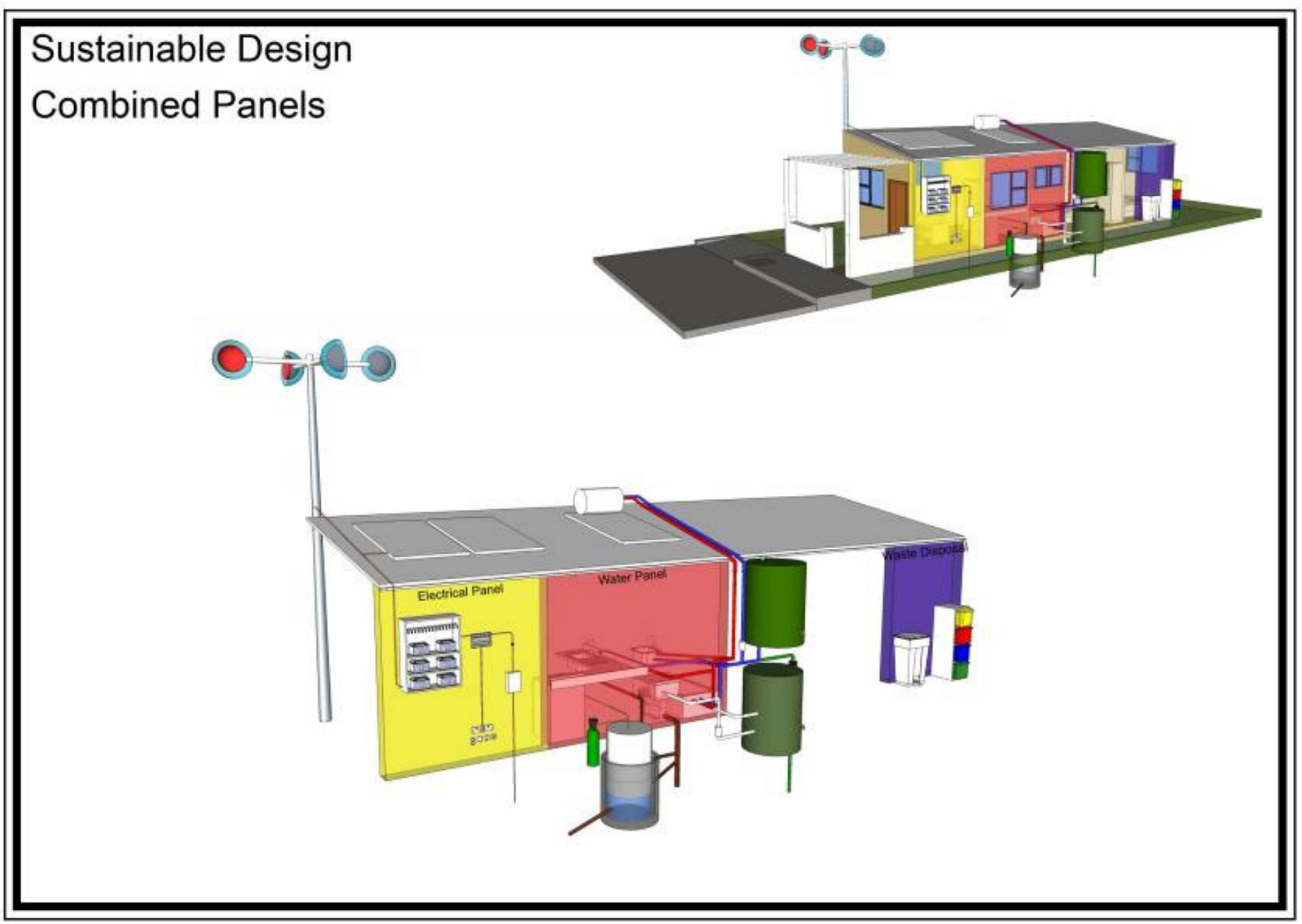
Sustainable Design

Water and Sewer Services Panel



Sustainable Design

Waste Disposal Panel


Sustainable Design
Combined Panels
Electrical Panel
Water Panel
Waste Disposal

SUSTAINABILITY CONSIDERATIONS

REFERENCES

THIS SECTION HAS BEEN TAKEN FORM THE FOLLOWING REPORTS PREPARED BY WSP GREEN BY DESIGN SUBMITTED AS PART OF THIS PROJECT:

ETHEKWENI HOUSING TYPOLOGIES
SUSTAINABLE DESIGN PROGRESS REPORTS NO 1 AND 2 (NOV 2009)
SUSTAINABLE MATERIALS (FEB 2010)

THE REPORTS LIST TEN PRINCIPLES FOR SUSTAINABLE CITIES; KNOWN AS THE 10 MELBOURNE PRINCIPLES AND ALSO PRESENTS AN OVERVIEW ON MAIN RATING TOOLS AND THEIR SUITABILITY WITHIN THE CONTEXT OF LOW-COST HOUSING IN SOUTH AFRICA.

THE DRAFT SANS 204 CODE FOR ENERGY EFFICIENCY IN BUILDINGS IS INTRODUCED, MENTIONED AND DRAWING ON SOME CONCLUSIONS THAT COULD INFLUENCE THE DESIGN OF LOW-INCOME HOUSES.

A COMPARISON OF MATERIALS IS MADE AND FINALLY THE REPORT COMPARES THE EFFICIENCIES OF DIFFERENT WATER RECYCLING SYSTEMS PROPOSED IN TERMS OF WATER AND SEWER USAGE AND DISCHARGE.

INTRODUCTION

IT SEEMS IRONIC THAT INFORMAL DWELLINGS BUILT BY THE OCCUPANTS THEMSELVES IN INFORMAL SETTLEMENTS ARE OFTEN DONE SO IN A MORE SUSTAINABLE MANNER THAN THOSE HOUSES BUILT BY CONTRACTED BUILDERS FOR THE FORMAL HOUSING SECTOR.

THIS IS NOT DELIBERATE OR BY CHOICE; BUT BY CIRCUMSTANCE. NATURAL RESOURCES ARE USED SPARINGLY, MATERIALS ARE REUSED OR RECYCLED, MATERIALS USED USUALLY HAVE LOW-EMBODIED ENERGY, WASTE IS RECYCLED, AND HOUSES CAN BE DISASSEMBLED.

IF THIS IS THE CASE, THEN THE FOCUS ON SUSTAINABLE DESIGN OF LOW COST HOUSING NEEDS TO BE SHIFTED FROM THE TYPICAL ELEMENTS OF SUSTAINABILITY, TO THE SPECIFIC CONTEXT OF LOW-COST HOUSING.

SINCE THE PRIMARY NEEDS OF THE OCCUPANTS OF LOW COST HOUSING ARE THEIR PHYSIOLOGICAL NEEDS (FOOD, WATER, SHELTER, CLOTHING), THEN SUSTAINABILITY MUST BE AN INTRINSIC PART OF THE HOUSE'S DESIGN AND FUNCTIONALITY, OTHERWISE IT WILL NEVER BE ADDRESSED.

ULTIMATELY SUSTAINABILITY NEEDS TO BE SEEN TO BE AN ELEMENT OF DESIRE TO THE OWNERS OF THESE HOUSES.

THE ETHEKWENI MUNICIPALITY PROVIDES HOUSEHOLDS WITH 9KL FREE POTABLE WATER PER MONTH. IF THE OCCUPANTS OF LOW COST HOUSING COULD EXIST WITHIN THIS FREE WATER ALLOCATION WITHOUT COMPROMISING HYGIENE, THIS WOULD PROVE TO BE A (I) FINANCIALLY, (II) ENVIRONMENTALLY AND (III) SOCIALLY SUSTAINABLE SOLUTION. A SIMILAR PHILOSOPHY WOULD APPLY TO THE USE OF ELECTRICITY AND ALTERNATIVE FORMS OF HEATING, LIGHTING AND COOKING.

SUSTAINABLE MATERIALS

GREEN STAR SA DOES NOT PRESCRIBE OR ENDORSE ANY PARTICULAR MATERIAL. HOWEVER, IT DOES PROVIDE GUIDANCE IN CHOOSING PRODUCTS THAT REDUCES OUR RELIANCE ON VIRGIN MATERIALS FOR MANUFACTURE, FAVOURS LOWER EMBODIED ENERGY PRODUCTS AND CALLS FOR RECYCLED/REUSED COMPONENTS TO BE USED. GREEN STAR SA IS ALSO CONCERNED THAT MATERIALS USED IN THE BUILDING ARE OBTAINED USING SUSTAINABLE MANUFACTURING PRINCIPLES, WHERE HARM TO THE ENVIRONMENT AND THE PEOPLE WHO LIVE IN IT IS MINIMISED.

REUSED AND RECYCLED MATERIALS

THERE ARE SEVERAL OPPORTUNITIES TO USE REUSED MATERIALS ESPECIALLY IN A LOW COST HOUSING ENVIRONMENT. PROCESSING OF PREVIOUSLY USED CLAY BRICKS AT BUILDING DUMP SITES ALREADY IS PREVALENT AND THESE MATERIALS MAY BE PURCHASED FOR HOUSING. NOT ONLY WOULD THIS PUT AN EXISTING “WASTE” MATERIAL BACK TO USE, BUT IT WOULD ALSO OFFER A MEANINGFUL INCOME FOR INDIVIDUALS WORKING IN THESE BUILDING DUMP SITES. SIMILARLY, DOORS AND WINDOWS ARE SALVAGED FOR RESALE FROM DEMOLITION SITES THROUGHOUT SOUTH AFRICA.

CONCRETE

PORTLAND CEMENT PRODUCTION IS AN EXCEPTIONALLY ENERGY INTENSIVE PROCESS. AS A MEANS OF REDUCING THE EMBODIED ENERGY CONTENT OF CEMENT, WASTE PRODUCTS SUCH AS FLY ASH OR INDUSTRIAL SLAG CAN BE INCORPORATED INTO THE CONCRETE MIX. WHILE THIS DOES NOT IMPEDE THE STRENGTH OF THE PRODUCT IN ANY WAY, THE STRENGTH OF THE CONCRETE DURING THE CURING PROCESS TAKES LONGER TO ATTAIN.

STEEL

STEEL THAT CONTAINS RECYCLED STEEL CONTENT REDUCES THE RELIANCE ON VIRGIN ORE BODIES, AND IS SHOWN TO HAVE A SUBSTANTIALLY LOWER EMBODIED ENERGY COMPONENT. IN SOUTH AFRICA, REBAR TYPICALLY HAS BETWEEN A 90-95% RECYCLED CONTENT, WHEREAS STRUCTURAL STEEL HAS A LOWER RECYCLED STEEL COMPONENT.

STEEL WOULD BE USED IN LIGHT STEEL FRAMED BUILDINGS WHERE THE WALL STRUCTURE AND ROOFING STRUCTURES ARE STEEL, DOORS, WINDOWS FRAMES, REBAR, STEEL MESH.

SANDBAG WALL CONSTRUCTION – 400 mm

PVC MINIMISATION

PVC HAS BEEN SHOWN TO LEACH DIOXINS THROUGHOUT ITS LIFECYCLE, FROM ITS PRODUCTION UNTIL DISPOSAL. THESE DIOXINS ARE POISONOUS TO THE FACTORY WORKERS IN THE PRODUCTION PROCESS, LEACH INTO THE SOIL AND WATER TABLE ON DISPOSAL, BUT POSE THE GREATEST RISK TO HUMAN LIFE WHILE INSTALLED IN BUILDINGS. DURING FIRES PVC RELEASES DIOXINS INTO THE ATMOSPHERE WHICH. THIS GAS CLAIMS MORE LIVES AND CAUSES MORE LONG TERM HEALTH DAMAGE THAN THE FIRE ITSELF.

IT IS RECOMMENDED THAT PVC APPLICATIONS BE REPLACED WITH ALTERNATIVE PRODUCTS WHEREVER IS POSSIBLE. MANY OPTIONS EXIST FOR PLUMBING APPLICATIONS, FROM HDPE AND PEX THROUGH TO COPPER PIPING. WHILE PVC REPLACEMENTS ARE AVAILABLE FOR ELECTRICAL FLEX, THEY ARE NOT WIDELY AVAILABLE AND EXPENSIVE. IT IS PREFERABLE NOT TO USE PVC FLOOR COVERING.

SUSTAINABLE TIMBER

IDEALLY TIMBER USED IN BUILDINGS SHOULD BE DERIVED FROM SALVAGED TIMBER WHICH IS REUSED FOR THE SAME FUNCTION, OR RECYCLED INTO NEW PRODUCTS FROM WASTE TIMBER. ALTERNATIVELY ALL TIMBER WORK USE IN THE BUILDING OF THE HOUSE AND FOR FITTINGS SHOULD BE SOURCED FROM FSC ACCREDITED FORESTS.

THE FSC ACCREDITATION IS AN ASSURANCE THAT THE FORESTS FROM WHICH THE TIMBER DERIVES IS MANAGED SUSTAINABLY, THAT THE WATER BODIES ARE NOT POLLUTED AND THE WORKERS AND INHABITANTS ARE FAIRLY TREATED. AN FSC ACCREDITATION CAN ONLY BE CLAIMED IF ALL PARTIES HANDLING THE TIMBER FROM FOREST TO MANUFACTURE HAVE CHAIN-OF-CUSTODY CERTIFICATION. THIS GUARANTEES THAT THE TIMBER IS GENUINELY OBTAINED FROM FSC ACCREDITED FORESTS.

IN ADDITION TO ALL TIMBER STRUCTURES AND FITTINGS COMPLYING THE ABOVE CRITERIA, ANY FORM WORK OR TIMBER PALLETS USED ON THE SITE SHOULD ALSO COMPLY. CURRENTLY 80% OF ALL FORESTS IN SOUTH AFRICA ARE FSC ACCREDITED. HOWEVER THE PROGRESS OF OBTAINING CHAIN OF CUSTODY CERTIFICATION IS NOT AS ADVANCED.

TIMBER PRODUCTS CAN BE FOUND IN DOORS, WINDOWS, ROOFING STRUTS, FACADES, INTERIOR WALLING, FLOORING AND PANELLING.

LOCAL SOURCING

IN AN EFFORT TO REDUCE THE EMBODIED CARBON OF PRODUCTS DERIVED FROM TRANSPORTATION, GREEN STAR SA REWARDS PRODUCTS THAT ARE SOURCED AS CLOSE TO THE SITE AS POSSIBLE. THIS CRITERION DOES NOT ONLY REFER TO THE MANUFACTURING SITE, BUT ALSO TO POINT OF EXTRACTION OF RAW MATERIALS.

GREEN STAR SA SPECIFICALLY REWARDS LOCALLY SOURCED MATERIALS PERMANENTLY INSTALLED IN THE BUILDING, BUT EXCLUDES MECHANICAL, ELECTRICAL, PLUMBING AND SPECIALITY COMPONENTS.

SANDBAG WALL CONSTRUCTION – 400 mm

LOCAL SOURCING

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LOW VOC AND LOW FORMALDEHYDE PRODUCTS

INDOOR AIR QUALITY IS HAMPERED BY OFF-GASSING OF VOLATILE ORGANIC COMPOUNDS INTO THE ATMOSPHERE. THESE GASES ARE CHARGED WITH CAUSING HEADACHES, EAR, NOSE AND THROAT IRRITATIONS, ECZEMA NAUSEA LETHARGY AMONGST VARIOUS AILMENTS. REMOVING THESE TOXINS FROM THE INTERIOR ENVIRONMENT HAS A POSITIVE EFFECT ON THE INHABITANTS' WELL BEING. VOC'S ARE PREVALENT IN PAINTS, SEALANTS, ADHESIVES AND CARPETS. FORMALDEHYDE WHICH IS USED AS AN ADHESIVE FOR BONDING ENGINEERED TIMBER PRODUCTS IS SINGLED OUT. THE EMISSIONS HAVE BEEN LINKED TO RESPIRATORY CANCERS.

WHEN SELECTING ANY OF THE AFOREMENTIONED PRODUCTS IT IS IMPORTANT TO ASCERTAIN THE VOC LIMITS. WHILE MANY SOUTH AFRICAN PAINT COMPANIES ARE STRIVING TOWARD EU2007 LEVELS IN THEIR PAINT, GREEN STAR SA LIMITS ARE FAR MORE STRINGENT. THERE ARE A FEW LOCAL CARPET SUPPLIERS WHOSE CARPETS COMPLY WITH GREEN STAR SA VOC LIMITS.

ZERO ODP INSULATION

INSULATION IS VITAL FOR IMPROVING AND MAINTAINING COMFORTABLE INDOOR THERMAL CONDITIONS. WHILE THE BULK OF INSULATION (FIBREGLASS, CELLULOSE, PET, ROCKWOOL) ARE MANUFACTURED WITHOUT USING BLOWING AGENT; EXPANDED POLYSTYRENE (EPS), EXTRUDED POLYSTYRENE (XPS), ELASTOMETRIC NITRIL FOAM AND POLYISOCYANUARATE (PIR) INSULATION AMONGST OTHERS, ARE MANUFACTURED USING HCFC BLOWING AGENTS. THESE GASES ARE STILL PERMITTED UNDER THE MONTREAL PROTOCOL UNTIL 2020, BUT THEY CONTAIN OZONE DEPLETING GASES. WHEN SPECIFYING INSULATION THAT USES ANY BLOWING AGENT IN ITS MANUFACTURE, NON-HCFC GASES NEED TO BE SPECIFIED. THE MOST COMMON REPLACEMENT GAS IS PENTANE, WHICH HAS NEITHER OZONE DEPLETING POTENTIAL NOR GREEN HOUSE WARMING POTENTIAL.

HAZARDOUS MATERIALS

FLOORS:	CONCRETE, INSULATION,
WALLS:	CONCRETE HOLLOW BRICK, CLAY BRICK, CEMENT BRICK, GYPSUM BOARD, INSULATION, ADOBE, TIMBER, PLASTER, STEEL, PAINT, WATERPROOFING
ROOF:	IBR , CLAY TILES, PLASTIC TILES,
FITTINGS:	DOORS, WINDOWS, PLUMBING, SANITARY WARE, SINK, WIRING.

SYNOPSIS

THE NEXT SECTION COMPARES THE EFFICIENCIES OF DIFFERENT WATER REUSE SYSTEMS TOGETHER WITH SANITATION ALTERNATIVES IN ORDER TO DETERMINE (I) POTENTIAL POTABLE WATER SAVINGS ACHIEVABLE, AND (II) THE REDUCTION IN WASTE WATER TO SEWER; FOR THE SIX HOUSING TYPOLOGIES.

POTABLE WATER DEMAND CAN BE REDUCED BY MEANS OF RAINWATER SYSTEMS, GREYWATER SYSTEMS OR DRY SANITATION.

WASTE WATER VOLUMES CAN BE REDUCED BY MEANS OF GREYWATER SYSTEMS OR DRY SANITATION.

THE SELECTION OF THE APPROPRIATE SYSTEM IS DEPENDENT ON THE ORDER OF PRIORITIES: MAXIMUM REDUCTION OF POTABLE WATER DEMAND OR MAXIMUM REDUCTION IN WASTE WATER TO SEWER. ALTHOUGH THESE REDUCTIONS DO NOT DIRECTLY CORRELATE WITH ONE ANOTHER, AN OVERALL OPTIMAL SOLUTION CAN BE ACHIEVED.

DESCRIPTION OF 6 SELECTED HOUSING TYPOLOGIES

TYPOLOGY NO.	OWNERSHIP	FRONTAGE TYPE	NO. STOREYS	LAYOUT	FOOTPRINT [M2] PER DWELLING	NO. OF OCCUPANTS PER DWELLING	NO. DWELLINGS
TYPOLOGY 5	MULTIPLE	NARROW	DOUBLE STOREY	SEMI-DETACHED	22	4	2
TYPOLOGY 8	MULTIPLE	NARROW	DOUBLE STOREY	SEMI-DETACHED	44	4	2
TYPOLOGY 21	MULTIPLE	MEDIUM	DOUBLE STOREY	SEMI-DETACHED	42	4	2
TYPOLOGY 22	MULTIPLE	MEDIUM	DOUBLE STOREY	DUPLEX ROW	42	4	2
TYPOLOGY 30	SINGLE	WIDE	SINGLE STOREY	DETACHED	43	4	1
TYPOLOGY 34	MULTIPLE	WIDE	DOUBLE STOREY	SEMI-DETACHED	43	4	2

WATER MODEL

PROPOSED SYSTEMS:

1. POTABLE WATER ONLY (WATER-BORNE SEWER)
2. RAINWATER + POTABLE WATER SUPPLY (WATER-BORNE SEWER)
3. GREYWATER + POTABLE WATER SUPPLY (WATER-BORNE SEWER)
4. POTABLE WATER ONLY (DRY SANITATION)
5. RAINWATER + POTABLE WATER SUPPLY (DRY SANITATION SYSTEM)
6. GREYWATER + POTABLE WATER (DRY SANITATION SYSTEM)

WATER MODEL ASSUMPTIONS

TOILETS:	**DUAL FLUSH (6/3 LITRE WC)** **2 TOILET FLUSHES (SOLID) PPPD @ 6 L PER FLUSH** **4 TOILET FLUSHES (LIQUID) PPPD @ 3 L PER FLUSH** **1 L PER DAY FOR TOILET CLEANING (FOR DRY SANITATION)**
WHB:	**6 HAND WASHES PPPD @ 6 L PER MIN FOR 10S**
SHOWER:	**1 SHOWER PPPD @ 8L PER MIN FOR 4 MIN**
COOKING:	**10 L PPPD** **(2 L FOR DRINKING, 4 L FOR COOKING, 4 L FOR DISHWASHING)**
LAUNDRY:	**3 L PPPD**
SPACE CLEANING:	**ONCE A WEEK @ 10 L PER CLEAN = 1.4 L PER DAY (REGARDLESS OF NO. OF PEOPLE)**

(PPPD ~ PER PERSON PER DAY)

WATER MODEL ASSUMPTIONS

WATER COLLECTION:

- POTABLE WATER: MUNICIPAL MAINS
- RAINWATER: HARVESTED FROM ROOF
- GREYWATER: COLLECTED FROM SHOWERS & WHB'S

WATER USAGE:

- MUNICIPAL WATER: COOKING & WASH HAND BASINS
- RAINWATER: SHOWERS AND LAUNDRY
- GREYWATER: TOILET FLUSHING & SPACE CLEANING
- ANY SURPLUS RAINWATER OR GREYWATER: IRRIGATION

FREE WATER ALLOCATION:

- 9 KL PER DWELLING PER MONTH

POTABLE WATER DEMAND PER DWELLING PER MONTH

SEWERAGE OPTION:	OPTION 1: WATER-BOURNE SEWERAGE	OPTION 1: WATER-BORNE SEWERAGE	OPTION 1: WATER-BORNE SEWERAGE	OPTION 2: DRY SANITATION	OPTION 2: DRY SANITATION	OPTION 2: DRY SANITATION
WATER SOURCE:	POTABLE	RAIN + POTABLE	GREY + POTABLE	POTABLE	RAIN + POTABLE	GREY + POTABLE
TYPOLOGY 5	9.2	7.4	6.2	6.2	4.5	6.2
TYPOLOGY 8	9.2	7.4	6.2	6.3	4.5	6.2
TYPOLOGY 21	9.2	7.5	6.2	6.3	4.6	6.2
TYPOLOGY 22	9.2	7.5	6.2	6.3	4.6	6.2
TYPOLOGY 30	9.2	5.7	6.2	6.3	2.8	6.2
TYPOLOGY 34	9.2	7.5	6.2	6.3	4.5	6.2

WASTE WATER TO SEWER PER DWELLING PER MONTH

SEWERAGE OPTION:	OPTION 1: WATER-BORNE SEWERAGE			OPTION 2: DRY SANITATION		
WATER SOURCE:	POTABLE	RAIN + POTABLE	GREY + POTABLE	POTABLE	RAIN + POTABLE	GREY + POTABLE
TYPOLOGY 5	9.2	9.2	4.5	6.3	6.3	1.7
TYPOLOGY 8	9.2	9.2	4.5	6.3	6.3	1.7
TYPOLOGY 21	9.2	9.2	4.5	6.3	6.2	1.7
TYPOLOGY 22	9.2	9.2	4.5	6.3	6.2	1.7
TYPOLOGY 30	9.2	9.2	4.5	6.3	6.3	1.7
TYPOLOGY 34	9.2	9.2	4.5	6.3	6.3	1.7

SUMMARY OF % REDUCTION OF POTABLE WATER AND WASTE WATER

WATER SOURCE	SEWERAGE SYSTEM	% POTABLE WATER SAVINGS ACHIEVED	% REDUCTION OF WATER TO SEWER	QUALIFICATION
POTABLE WATER	MUNICIPAL SEWER	-	-	-
RAINWATER + POTABLE	MUNICIPAL SEWER	20%	-	2 OWNERS (DUPLEX) 4 OCCUPANTS PER HOUSE
		38%	-	1 OWNER 4 OCCUPANTS
GREYWATER + POTABLE	MUNICIPAL SEWER	33%	51%	4 OCCUPANTS
POTABLE WATER	DRY SANITATION	33%	32%	4 OCCUPANTS
GREYWATER + POTABLE	DRY SANITATION	33%	73%	4 OCCUPANTS
RAINWATER + POTABLE	DRY SANITATION	51%	32%	2 OWNERS (DUPLEX)
		70%	32%	1 OWNER

OBSERVATIONS

WATER SUPPLY:

OCCUPANTS CAN EXIST WITHIN THIS 9KL FREE WATER ALLOCATION, ASSUMING A WATER-BORNE SEWERAGE SYSTEM IS IN PLACE.

BUT NEED TO CONSIDER:

- MORE OCCUPANTS PER DWELLING REQUIRE >9KL
- POTENTIAL INCREASE IN WATER TARIFFS

SANITATION:

DISADVANTAGES OF WATER-BORNE SANITATION:

- HIGH COST TO PROVIDE BULK SEWER SERVICES
- SEWER LINES DICTATE THE URBAN FORM
- INCREASED WATER DEMAND FOR FLUSHING

ADVANTAGES OF DRY SANITATION:

- NO BULK SERVICES REQUIRED
- ALLOWS FOR FLEXIBILITY OF DESIGN OF THE URBAN FORM
- REDUCES WATER DEMAND (WATER ONLY REQUIRED FOR CLEANING TOILETS)

RECOMMENDATIONS

DEPENDENT ON PRIORITY IE:

- **REDUCTION IN POTABLE WATER DEMAND OR**
- **REDUCTION IN WASTE WATER TO SEWER**

1. **FOR REDUCTION IN POTABLE WATER DEMAND :**
   A RAINWATER SYSTEM + DRY SANITATION IS RECOMMENDED FOR ALL 6 TYPOLOGIES.

2. **FOR REDUCTION IN WASTE WATER TO SEWER:**
   A GREYWATER SYSTEM + DRY SANITATION IS RECOMMENDED FOR ALL 6 TYPOLOGIES.